MINING WORLD

JUNE 1960

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"Imagination... is the source of human improvement; experience its implement"

Phillips Petroleum Company, Grants, New Mexico

URANIUM... AND THE PATTERN OF A NEW ERA

Today, the world is heir to countless miracles of the new era of atomic energy, thanks, in large measure, to uranium and the technological and scientific skills that have put it to work.

The interest of WKE engineers in this new age stems from experience in design, engineering and construction of twelve of the twenty-five operating or planned uranium plants in the United States. These twelve operations include a wide range of capacities, ore types, processes and specialized equipment. In each case, success has been the result of imaginative application of proved techniques in chemical metallurgy, beneficiation, materials handling and instrumentation, plus construction experience. WKE has successfully executed over forty contracts in this "new era" industry — from evaluations and feasibility reports through construction and start-up.

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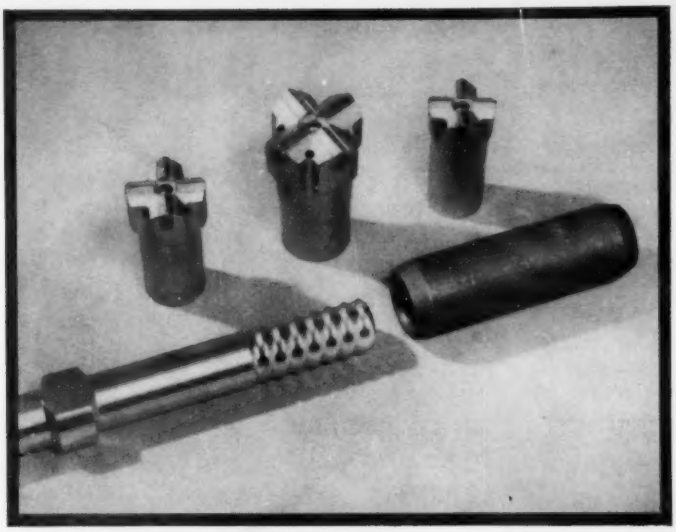

Here's proof Coromant rope-thread bits and steels SAVE TIME AND MONEY

"Up to double the footage between sharpenings!"
"Premature rod breakage is almost non-existent!"
"40% more usable life—more resharpenings!"
"Bit and rod life are well above average!"
"Uncouple by hand all the time!"
"More rigid—drills straighter holes!"*

**Names of men quoted available on request*

The comments above are actual quotes from project managers, job superintendents, and drill superintendents who have tested new Coromant rope-thread bits and steels. They've learned, on-the-job, the benefits they—and you—can expect!

For example: The new rope-thread (only two turns per inch) holds tight in use, yet permits hand uncoupling. Reports show that the time saved results in more footage drilled per shift. Bit footage is well above average too, with less loss of carbide inserts. Prime quality ore plus nickel-chrome alloy permits cold-rolling from billets for greater strength, life and rigidity. And only with Coromant rope-thread steels can you re-thread without heat treating, too. Do it yourself, or at any nearby machine shop.

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REALLY SHARP ON TURNS

The all-hydraulic, 20-ton capacity TR-260 makes U turns in less than 26½ ft . . . saves up to 15 seconds per cycle over conventional haulers.

The 230-hp Allis-Chalmers TR-260 turns in less space than any wagon of comparable size. Complete U turns are made in less than 26½ ft. All-hydraulic, 2-stage steering with double-acting steering jacks gives you 2-way power pulling out of full turns. At the shovel and hopper, this kind of turning can save you up to 15 seconds per cycle over conventional haulers.

In addition, the sharp-turning TR-260 also gives you the benefits of KON-TORK *differential* and *plenty of tractor and wagon underclearance* to keep you on-the-go.

These are just a few reasons why the 20-ton capacity TR-260 brings you extra profits on your hauling jobs. Your Allis-Chalmers dealer will give you all the facts on both the TR-260 and the 12-ton capacity TR-160. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

You get double value and lower basic equipment investment when you use the 9.5-cu-yd TS-160 and 17-cu-yd TS-260, the 12-ton TR-160 and 20-ton TR-260 units. Both can be interchanged . . . together they eliminate need for specialized equipment.

KON-TORK is an Allis-Chalmers trademark.

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power for a growing world

MINING WORLD

. . . . . including the Export Edition, WORLD MINING

VOL. 22 NO. 7 June 1960

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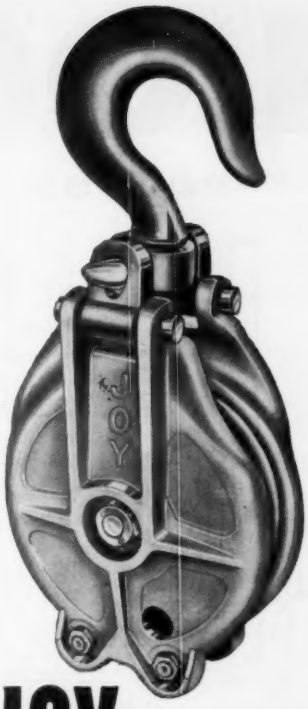

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Write for Bulletin 287-8

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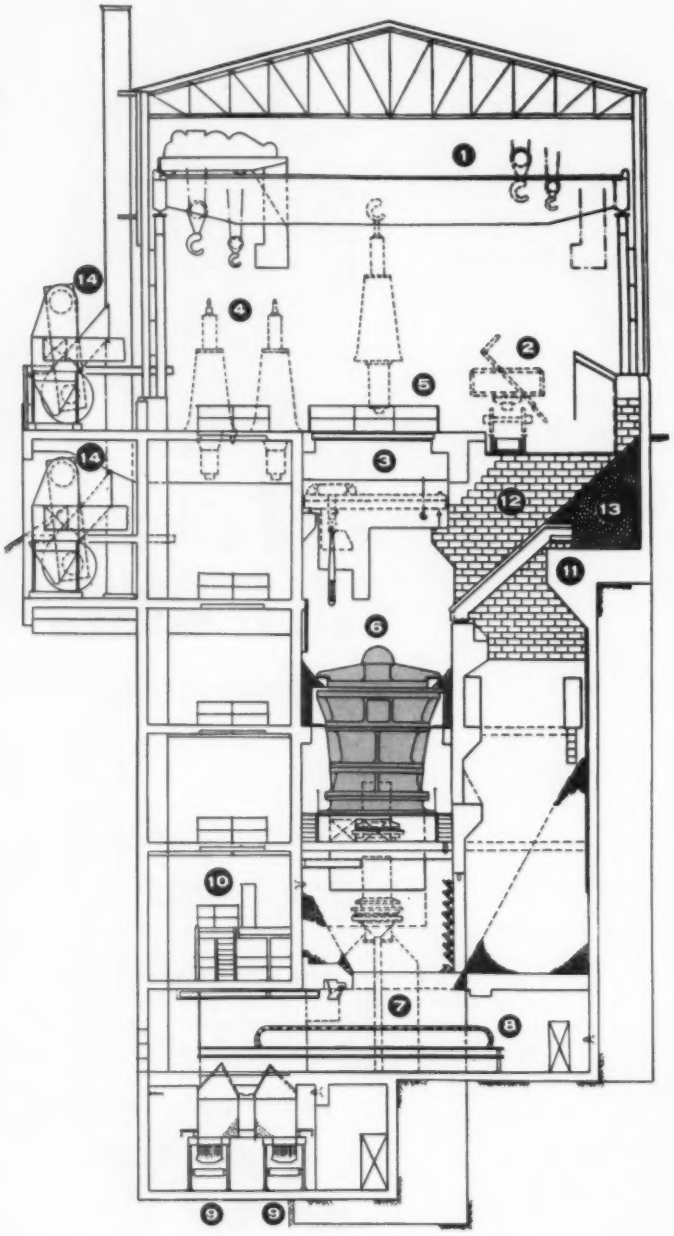
POUNDS OF TRAYLOR ENGINEERING!



TRAYLOR

world's largest manufacturer of 60" gyratory crushers designed and built this giant for installation in Peru.

The Southern Peru Copper Corporation called on Traylor-made ECONOMY, EFFICIENCY, AND CAPACITY to handle the tremendous crushing workload at its new plant in Toquepala, Peru.

Drawing shows Traylor 60" gyratory crusher operation:

1. 100-ton crane with 25-ton auxiliary hook and operator's cab
2. 43-cu. yd. side-dump mine car
3. 20-ton crane with rock hook
4. Mantle storage
5. 18 x 22-ft. removable hatch
6. 60-in. Traylor gyratory primary crusher
7. Hydraulic hoist, 14-ft. lift, 25-ton capacity
8. Two 72-in. pan feeders
9. Two 54-in. chain-belt conveyors
10. Electrical control panel
11. 8-in. grizzly
12. 2-in. plate liners
13. Dead-bed areas
14. Air filter dust removal unit

Other Traylor Crushers made for primary, secondary or fine reductions. Write today outlining your crushing requirements and let Traylor's engineers make recommendations . . . or ask for Bulletin No. 1126.

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Go Slow On Changes

Undersecretary of the Interior, Elmer F. Bennett recently said at a meeting of the Mining and Metallurgical Society of America that, "surface prospecting as a means of ore discovery is as outdated as the mule and new legislation is needed to keep up with the new techniques and scientific methods that are replacing surface prospecting."

"The ability of the mining industry to compete with foreign production may often depend in the future on the discovery of low-cost, subsurface deposits of needed minerals," he added. He then made the remark that, "Industry will have to have the incentive of adequate protection for its investments, or these deposits will not be found."

By low-cost subsurface deposits Mr. Bennett must mean high-grade, as the growing trend to low-cost production has been to surface open-pitting and there is no sign of any slowing of this trend.

What can new mining legislation do to help find high-grade ore? We are certain the Undersecretary was referring to the mining law relating to mineral discovery, location, and patenting. There is no need for any changes in these laws. Witness recent successes for non-outcropping ore at Safford, Mission, Tintic Burgin, and Shirley Basin to name a few on claims. In the east where claims are not too important there are Copper Ridge, Viburnum, Deep White Pine, Eminence, and many more.

The big need is right in Mr. Bennett's Interior Department. Cut down the delays, the inefficiencies, the mass of red tape, and the other difficulties imposed on any person or company patenting a mining claim.

Don't change the law. Speed up the system long established by law.

Orient Revisited

Mining in the Philippines has undergone many changes since the September 1955 "Philippine Mine Issues" of MINING WORLD. Mining has expanded in face of major problems. In 1955 there were only two important copper mines. Today there are five. One operates the most important block caving mine in the Far East, another mine produces the only by-product molybdenum in that part of the world. Technology is tops. Despite low grade and often metallurgically complex ore, the problems of securing equipment and supplies, and long distances to smelters, there have been many notable mine developments. This means that it's time for a return to the Philippine Islands. That's where Editor George O. Argall, Jr. is now. Watch for his first report.

He will also visit Japan to learn where this aggressive country will expand mining and ore purchasing next. The Japanese mining and smelting industry is of growing importance right now in Alaska, British Columbia, Nevada, Mexico, Peru, Chile, Brazil, India and other countries.

55-ton "Eucs"...21 of them...at new copper mine

At a big open pit copper mine near Tucson, Arizona, a fleet of Model R-55 Rear-Dump Euclids will move over two million tons of waste overburden each month during the mine preparation period. When the property enters the production phase, these "Eucs" will deliver mine ore to the primary crusher in addition to continued operation on the waste haul.

Working around the clock, the haulage units are loaded with 55 tons of waste by big 9-yd. shovels. Hauls to dumping area are about a mile in length. With separate engine and Torqmatic Drive for each rear axle, the Model R-55 has 670 total h.p. Since there is no clutch, changes from one speed range to another are made under full power with no loss of momentum . . . and converter lock-up provides maximum efficient use of engine power on grades and long, high speed hauls.

Euclid's modern rear-dump haulers . . . from the 10-ton Model R-10 to the big R-55 . . . give you a wide range of capacities and models that fit every mine and quarry job. Unmatched field experience, backed by parts and service facilities of a world-wide dealer organization, cuts downtime and pays off in better production. Have a Euclid dealer show you how Euclid's greater dimension can mean lower costs on your work.

EUCLID Division of General Motors, Cleveland 17, Ohio
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A complete line of rear-dump haulers with payload capacities of 10, 15, 18, 22, 27, 40 and 55 tons.

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EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE

CAPITOL concentrates

GOVERNMENT ACTION AND REACTION AFFECTING MINING

Multiple-Use Forest Bill Will Hurt Mining . . .

Congressman Aspinall of Colorado is highly critical of the Department of Agriculture for its failure to include prospecting and mining among the purposes for which the national forests shall be administered. The bill under fire is H. R. 10572 (and some 50 similar measures) which would establish as a national policy that national forests shall be administered for "outdoor recreation, range, timber, watershed, fish and wildlife uses."

"If it is intended that only the five uses named in the bill would be permitted on national forest land, I would have to object since there are other traditional and legitimate land uses that are not included," Aspinall stated. "Among these are prospecting, mining, water storage, rights-of-way, and industrial or occupancy uses in limited areas."

Aspinall suggested redefining multiple-use to include, but not limited to "forestry, grazing, habitat for fish and game, outdoor recreation, prospecting and mining, watershed protection and water-supply purposes." He also predicted that the question of whether or not the Forest Service is properly a division of the Department of Agriculture rather than Interior is likely to be raised by the bill. H. R. 10572, requested by the Department of Agriculture, has been favorably reported by the House Agriculture Committee and now awaits House action. ■

Revision Of Stockpiling Legislation Forecast . . .

Eventual revision of United States regulations governing the stockpiling of strategic and critical materials and government inventories is indicated in a reply by the United States to a United Nations questionnaire. In its extended reply, the United States commented that the objective of such revision would be "to bring all government stocks of nonagricultural material within one statutory framework," and to simplify their management and disposal. The reply also noted that "experience has shown that it is advantageous to be legally free to dispose of excess stocks without the prolonged delay and procedural formalities which are now mandatory for stockpiled materials," otherwise disposal cannot be timed to coincide with the best market opportunities.

"Any revision of the disposal safeguards of the present law," the report continued, "would be directed toward attaining more flexibility in this respect, while preserving the principle of avoiding undue disruption of markets and giving adequate advance notice."

The United Nations questionnaire had been sent to member countries on behalf of the Commission on International Commodity Trade. Through it, the agency hoped to determine what measures had been taken at governmental level to stabilize the prices of primary products or the incomes of their producers ■

Anderson Offers No Comfort To Gold Problem . . .

At a meeting of Industry Management in Chicago on April 26, 1960, Secretary of the Treasury Anderson made some interesting remarks about our monetary situation. He said, "The amount of foreign liquid dollar holdings which can with confidence be maintained is not unlimited. The increase in such holdings under the impact of payments deficits of the size of those of 1958 and 1959 cannot be allowed to continue indefinitely, since such a development would in itself make the maintenance of confidence difficult. With the dollar performing the vital function of the major reserve currency for the free world, the consequences of a loss of integrity of our money would indeed be serious and long-lasting."

However, in discussing various means of correcting the gold outflow, Anderson gave no comfort to those who believe a rise in the gold price is the proper cure. ■

Hardy's Testimony Again Endorses Lead-Zinc Quotas . . .

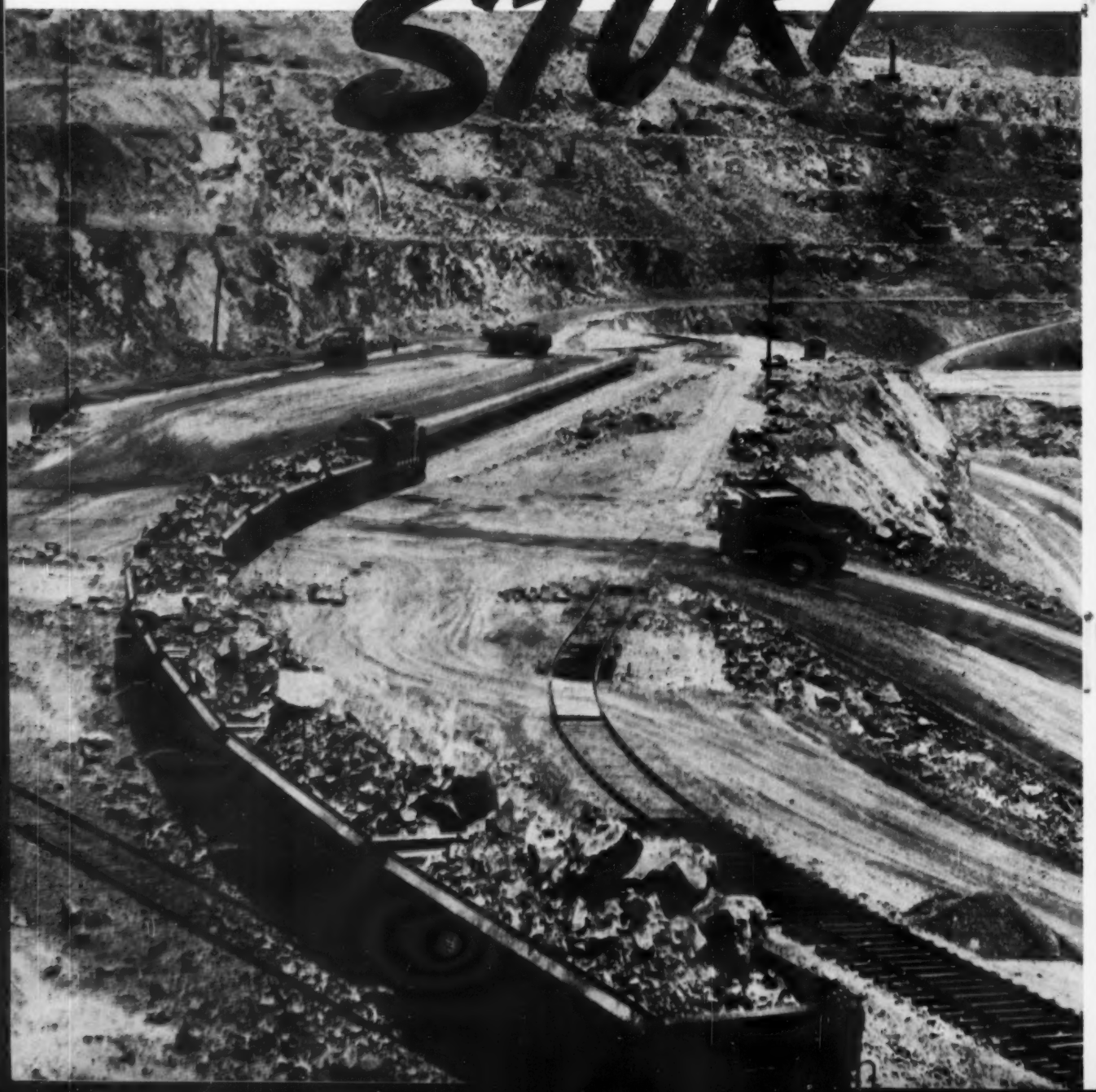
The House Interior Committee recalled Assistant Secretary for Mineral Resources Royce Hardy to testify on Tuesday, April 19, 1960, to see if the position of the Interior Department had changed since the issuance of the United States Tariff Commission report on lead and zinc. It had not.

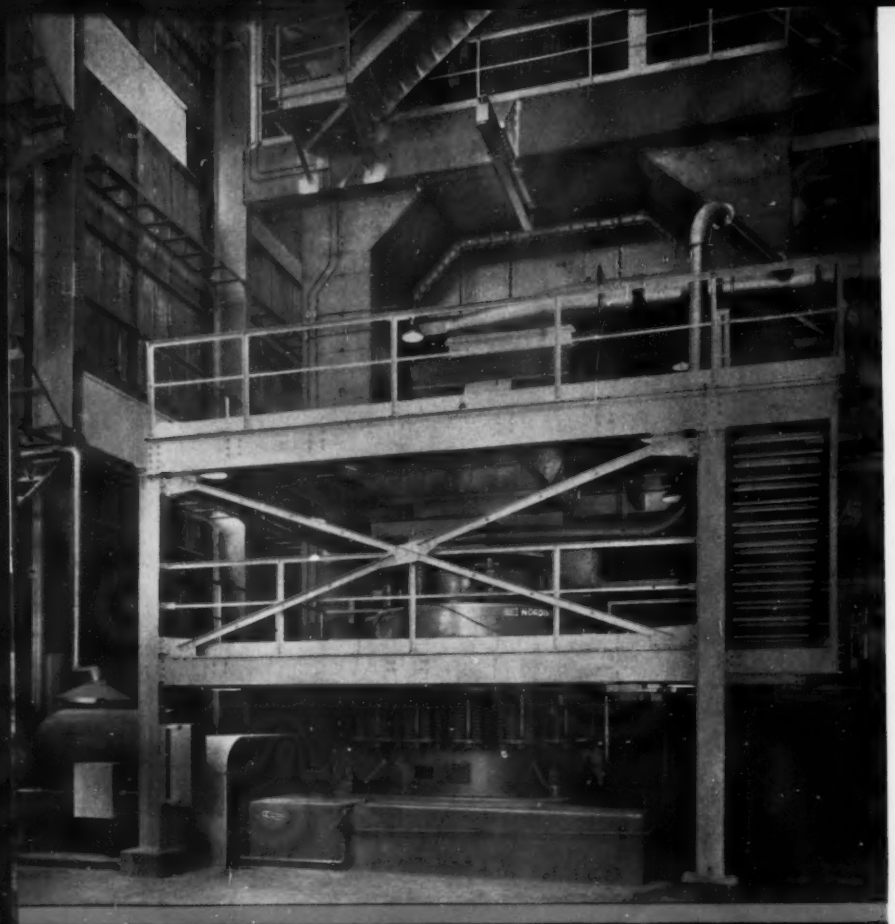
Hardy told the committee: "We believe that the most effective basis for the long run welfare of the domestic lead mining industry can be achieved by the continuance of the quotas." He maintained again that the improvement in the zinc situation is largely due to the quota system, although he gave some credit to increased consumption. He stated that the quota system had resulted in a 40 per cent increase in domestic zinc production and a 30 per cent improvement in prices. This sums up the hearing.

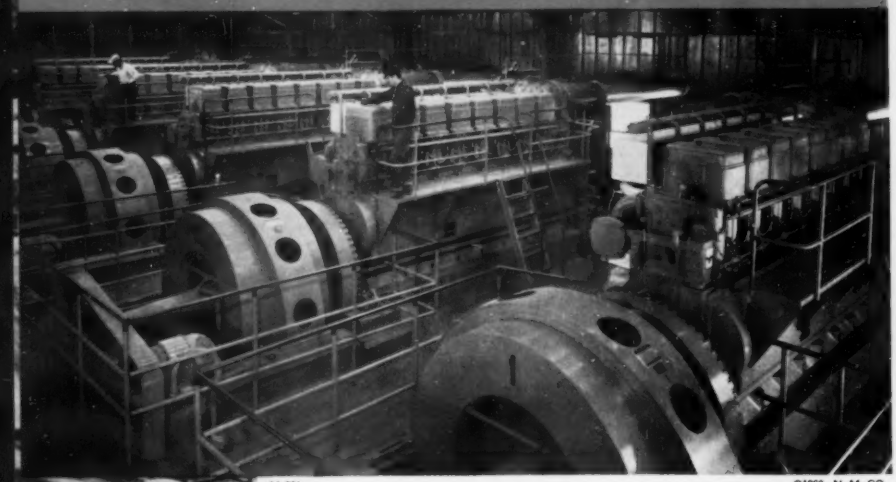
Quite evidently the Interior Department does not agree with the Tariff Commission minority report, or some of the suggestions in the majority report (which made no recommendations). It would be indeed interesting to know if the State Department has any new notions, and it is too bad that some of its officials were not called upon to testify. ■

Nordberg Machinery plays important part in the

"TOQUEPALA STORY"







M-250

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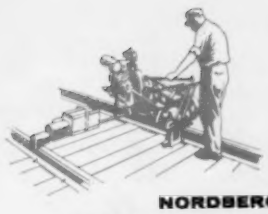
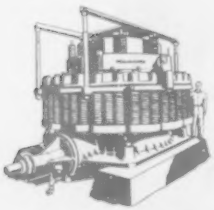


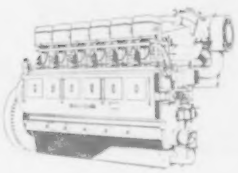
NORDBERG TRACK EQUIPMENT

An extensive railway system serves the Toquepala mine facilities. Nordberg equipment used by the contractor in laying rail included Power Jacks, Power Wrenches, Rail Drills, and a Hydraulic Spike Puller.



SYMONS® CONE CRUSHERS

Six Symons Cones handle secondary and tertiary crushing at the big Southern Peru Copper Corp. plant. Two of these are Standard units, and four are of the Short Head type.



NORDBERG ENGINES

Five Nordberg 4-cycle diesel engine-generator units are installed at the mine, 10,600 feet above sea level. Each of the 8-cylinder Nordberg supercharged engines is rated 1830 bhp, 1295 kw at their installed altitude.

The huge Southern Peru Copper Corp. open pit copper mine at Toquepala, Peru, is one of the major new mining projects of this decade. It is now in production, after more than five years of planning and development through the combined efforts of four large metal mining companies. Each of these companies have used Nordberg Machinery in their far-flung mining operations.

For, at Toquepala, as in most of the world's great ore and mineral operations, Nordberg Mining Machinery is playing an important part in the production of large tonnages of ore at low cost per ton.

NORDBERG MANUFACTURING COMPANY

Milwaukee 1, Wisconsin

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With the planet-powered 230-hp TD-25 pushing—and with 375 high-torque International Diesel hp under the "295's" hood—you heap on 34-cu. yd. with amazing new speed. Even in toughest loading conditions, "X"-member reinforcing maintains perfect Payscraper push-frame alignment!

Note that the Payscraper apron lifts to a big 94-inch opening. Two ejector-plate pushing members apply dozer-like action to force out the whole 34-cu. yd. load cleanly. The 122-inch bowl width speeds unloading, and loading, too—adds control ease and stability, loaded or empty.

How Payscraper power and power controls boost your dirt-on-fill delivery!

You get highest power-to-payload punch of all rubber-tired rigs in the 34-cu. yd. International 295 Payscraper. The fast-slugging, high-torque 6-cylinder International DT-817 Diesel is the Payscraper power plant.

The direct-start, 375-hp DT-817 is turbocharged to give you all-altitude, high-efficiency performance—power for cycle-speeding rim-pull—plus time-saving "no-lag" control power!

You power-shift the Payscraper, up or down—and the 4-speed planetary-type, torque-converter transmission provides load-speeding *automatic* direct-drive lock-ups in second, third, and fourth gears!

You power-steer the 150,000-lb. loaded Payscraper almost as easily as a 3,600-lb. automobile. Payscraper gives you the big control advantages of (1), exclusive International rack-and-pinion plus tandem pump steering system; and (2), 3-degree forward spindle pitch that improves scraper balance and prevents "nose-downs" in high-speed turns!

You power-control Payscraper dirt-handling actions with fingertip ease with the International PTO-driven Cable Control Unit. One cable drum of this simple planetary system actuates the apron and ejector; the other drum positions the bowl to control loading and spreading! Reach-easy Payscraper power brakes give you fast, positive stopping!

Ease into the bump-smothering Payscraper seat—press the direct-start button—power-shift the outfit into action. Compare the speed of loading, roading, and dumping the 122-inch bowl. See how the advantages of DT-817 Diesel power and complete, positive Payscraper power control can boost your dirt-on-fill delivery. Choose the 2-axle "295," or 3-axle, 34-cu. yd. "495." See your International Construction Equipment Distributor for a demonstration!

Here's your 76-page cost and production estimating book—newest, most authentic and complete guide for estimating material-moving costs—and for selecting equipment combinations for top profits, *anywhere!* Yours for the asking from your International Construction Equipment Distributor!

International® *Construction Equipment*

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Ill.

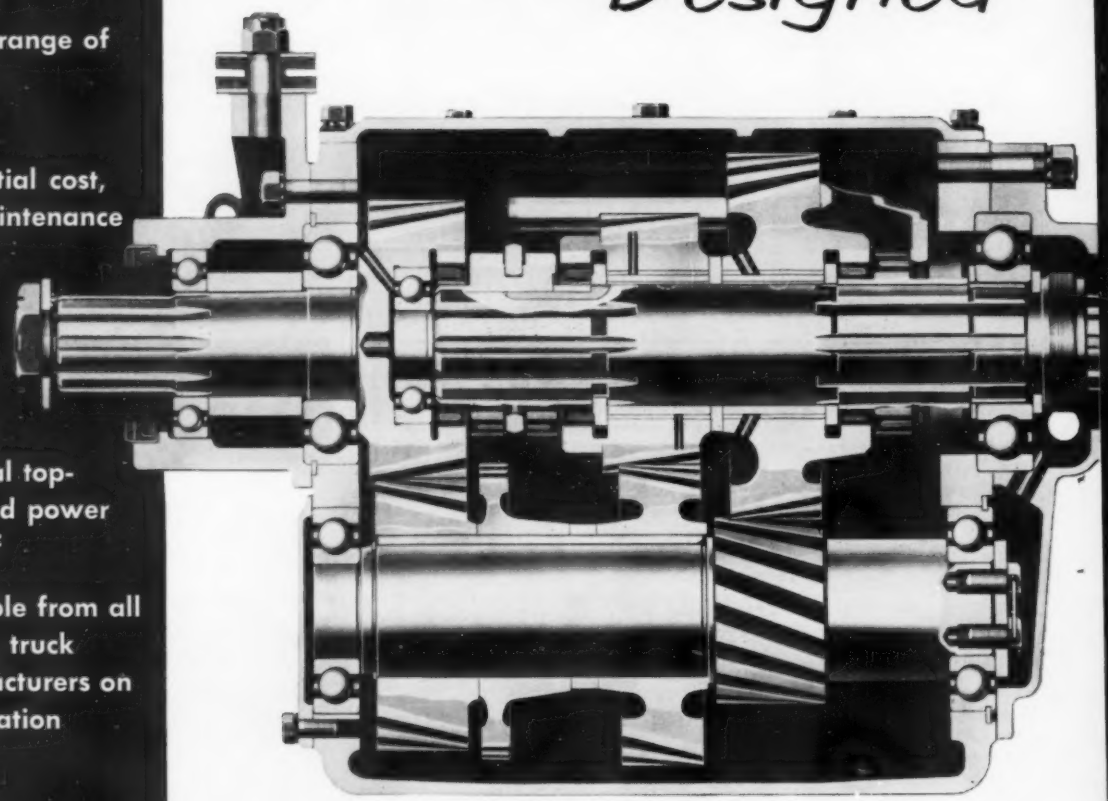
A COMPLETE POWER PACKAGE

Positive power-control of all operations adds safety, builds operator confidence — makes him "haul-speed minded" to help you get full capacity and profit from Payscraper speeds up to 33.5 mph. For example, safe, effortless tandem-pump power-steering leaves "the steering feel in the steering wheel"—gives positive, one-hand control!

Specify FULLER . . .

16 MODELS OF FULLER Designed

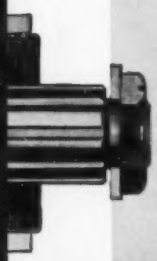
- High capacity
- Widest range of ratios
- Low initial cost, less maintenance
- Optional top-mounted power take-off
- Available from all leading truck manufacturers on specification



Specify the MODEL

3-SPEED AUXILIARY TRANSMISSIONS

for YOUR job!



For MEDIUM-HEAVY DUTY, specify the Fuller 65 Series 3-speed Auxiliary

65 Series: Ratios

MODEL	SPLITTER RATIOS High	SPLITTER RATIOS Inter-mediate	DEEP REDUCTION Low
3-A-65	.754	1.00	2.221
3-B-65	.804	1.00	1.239
3-C-65	.754	1.00	1.239
3-D-65	.804	1.00	2.221
3-E-65	.804	1.00	1.74
3-F-65	.754	1.00	1.74
3-G-65	1.00	1.32	2.221
3-H-65	1.00	1.32	1.74

For HEAVY DUTY, specify the Fuller 92 Series 3-speed Auxiliary

92 Series: Ratios

MODEL	SPLITTER RATIOS High	SPLITTER RATIOS Inter-mediate	DEEP REDUCTION Low
3-A-92	.74	1.00	2.09
3-B-92	.84	1.00	1.24
3-C-92	.75	1.00	2.64
3-D-92	.75	1.00	1.24
3-E-92	.84	1.00	2.09
3-F-92	.84	1.00	2.64
3-G-92	1.00	1.327	2.09
3-H-92	1.00	1.327	2.64

P.S. Fuller also offers three heavy-duty 3-speed Auxiliaries with built-in high-torque power take-off. Ask your dealer about the Fuller 3-T-92 Series Auxiliaries.

FULLER — TRANSMISSION DIVISION — MANUFACTURING COMPANY

KALAMAZOO, MICHIGAN

Subsidiary EATON Manufacturing Company

Unit Drop Forge Div., Milwaukee 1, Wis. • Shuler Axle Co., Louisville, Ky. (Subsidiary) • Sales & Service, All Products, West. Dist. Branch, Oakland 6, Cal. and Southwest Dist. Office, Tulsa 3, Okla. Automotive Products Company, Ltd., Automotive House, Great Portland Street, London W.1, England, European Representative

CATERPILLAR ANNOUNCES 2 NEW

NEW 150 HP 977H WITH 2½ CU. YD. BUCKET

Travel speeds: Forward—Low: 2.0 MPH 1st; 3.6 MPH 2nd. High: 2.5 MPH 1st; 4.7 MPH 2nd. Reverse speeds 25% faster than forward.

NEW 100 HP 955H WITH 1¾ CU. YD. BUCKET

Travel speeds: Forward—Low: 2.1 MPH 1st; 3.9 MPH 2nd. High: 2.7 MPH 1st; 4.9 MPH 2nd. Reverse speeds 25% faster than forward.

TRAXCAVATORS

with Power Shift Transmission and Live Action Hydraulics

977 SERIES H
955 SERIES H

all new for new high production

There is a way to beat higher costs—and that's with increased production. For tractor-loader jobs, here's your answer in the new Series H Cat 977 and 955 Traxcavators. Designed to set a production pace far faster than the models they replace (and other makes of comparable size), they're milestones in tractor-loader progress. With power shift transmission and Live Action Hydraulics, they're the loaders *that never stop.*

There may be machines in your line-up that are no longer paying their way—or not earning *all* the profits they should. A comparison of your existing loaders with the new Series H Traxcavators could easily prove these new machines would increase your output and profits far more than you imagine. Get the facts from your Caterpillar Dealer. Ask for a demonstration, too. See for yourself how they set a new production pace on the toughest kind of job.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

CATERPILLAR

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

TRAXCAVATORS ARE MAKING OTHER LOADERS OBSOLETE

NEW HIGH PRODUCTION FEATURES SPEED LOADING, LIFTING, HAULING, DUMPING . . . THE FULL CYCLE

NEW POWER SHIFT TRANSMISSION

One lever—that's right, one lever gives split-second changes in speed or direction to slash cycle times and increase operator efficiency.

NEW LIVE ACTION HYDRAULICS

Another Caterpillar development! Live Action Hydraulics provide faster lifting speed and greater lifting capacity without robbing power from the tracks. The 977H Traxcavator packs 41% more hydraulic lifting power—the 955H, 23% more than former models.

MORE HORSEPOWER WITH NEW CAT TURBOCHARGED ENGINES

Up 50% on the 977H—its new Cat D333 Engine develops 150 HP at the flywheel. Up 43% on the 955H with a new Cat D330 Engine that develops 100 flywheel HP.

NEW INCREASED BUCKET CAPACITY

An 11% increase on the new 977H with new 2½ cu. yd. bucket—and a 16.6% increase on the 955H with new 1¾ cu. yd. bucket. Complete redesign of engine, power train and chassis provides new machine balance to handle the heavier loads.

NEW HEAVY-DUTY UNDERCARRIAGE

Many new features, including larger, stronger track components that also increase stability . . . lifetime lubricated rollers with patented floating ring seals need no servicing . . . and track guiding guards welded to the roller frame for positive track alignment. The 955 Series H Traxcavator also features a new 6-roller track frame and hydraulic track adjusters, both standard equipment.

MORE HIGH PRODUCTION FEATURES

A new, two-cylinder gasoline starting engine for positive starts in any weather . . . and a new dry-type air cleaner that removes at least 99.8% of all dirt from intake air in the worst dust conditions, cuts maintenance time as much as 75%. Retained features include 40° bucket tilt back . . . automatic bucket positioners and kick out . . . 3-grouser track shoes.

QUICK-CHANGE ATTACHMENTS

Bar none, Traxcavators are the most versatile machines you can use. With attachments, you can always keep them working—and working profitably. Attachments available for the new 977 and 955 include the Side Dump Bucket, Rock Bucket, Quarry Bucket, Bulldozer, Ripper and Log and Lumber Forks.

Here's TEAMWORK FOR PROGRESS

This 3½-yd Koehring 1205 has torque-converter drive—also available with mechanical drive.

NOW...

Koehring 1205 is powered by 21000 Diesel

Several factors influenced Koehring engineers to select the Allis-Chalmers 21000 diesel for their Model 1205 crane-excavator.

Outstanding performance, of course, was the prime convincer. The 21000 provides plenty of power — and still works at far below its design capacity. Torque is consistently high throughout the entire working range — for both lugging ability and top performance at high speeds. Users report quick starting, without ether, in sub-freezing weather.

Modern design of the 21000, with its entirely new controlled-turbulence, open-combustion system, appealed to Koehring.

Big fuel savings — The turbocharged 21000 uses 8 to 27 percent less fuel than other diesels in its class. That means savings of up to 1 gallon in every 4!

Dependability to match — Since fuel is *burned* — it isn't left to "gook" up rings, valves, crankcase. Raw fuel doesn't wash away or dilute lube oil. Fuel makes horsepower, not waste heat. Further, there's tough, heavy-duty design, with "stay-on-the-job" durability in every part.

Pluses like these have led Koehring and other manufacturers to standardize on the 21000 and the companion naturally aspirated 16000 diesels. Get full information from your dealer or contact Allis-Chalmers, Engine — Material Handling Division, Milwaukee 1, Wisconsin.

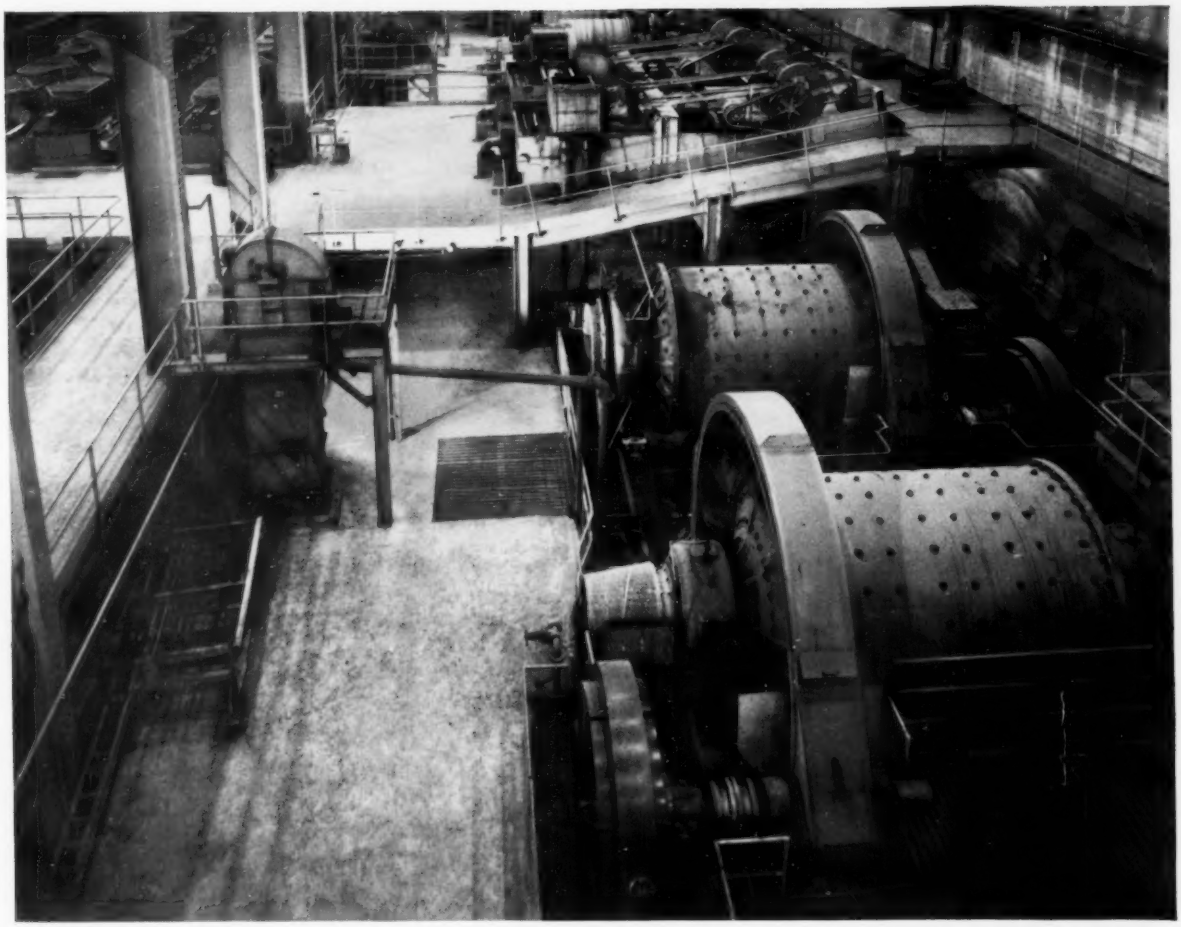
Go first class... use

ALLIS-CHALMERS

power in all your equipment

TEAMWORK FOR PROGRESS

BC-30



Good for long grind. Ni-Hard liners save labor, cut maintenance and grinding costs by providing the utmost in tonnage-life. Results obtained in this grinding aisle at Inco-Canada show the type of economies you can count on for your own mills.

Ni-Hard shell liners wear only .018 lb per ton grinding more than 3 million tons of nickel ore

This high tonnage-life demonstrates the outstanding performance of Ni-Hard* nickel-chromium white iron shell liners in the plant shown above.

In service since 1951, two sets of Ni-Hard lifter bar liners were removed recently from the rod mills here at Inco's Creighton concentrator in Canada.

Used in large mill

The Ni-Hard shell liners served in 10′8″ x 13′ mills grinding highly abrasive nickel ores with 3″ and 3½″ rods. Mills ran at 60% of critical speed. At the discharge, solids in the slurry ran 70%. Total life in the #1 mill was 3,430,000 tons of ore; in #4 mill, 3,266,000 tons. The liners for each mill originally weighed 60,912 lbs.

This example of Ni-Hard shell liner service is a severe one . . . nickel ores are among the toughest. But the record of Ni-Hard liners in such service points up what this material can do in all grinding operations.

For answers to your further questions about Ni-Hard liners, just pick up the phone and call your nearby Ni-Hard producer. Or write Inco directly. We'll send you a list of authorized producers and a copy of the useful booklet, "Engineering Properties and Applications of Ni-Hard."

*Registered trademark

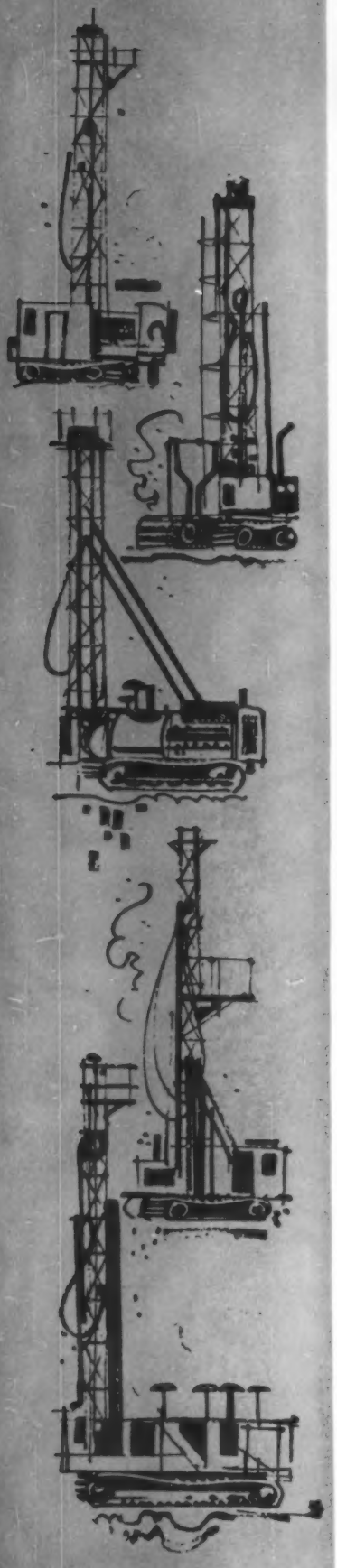
THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street — New York 5, N. Y.

INCO

NI-HARD

NICKEL MAKES ALLOYS PERFORM BETTER LONGER



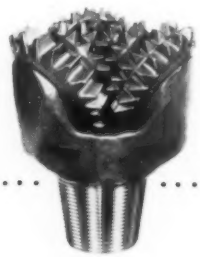
HUGHES "Rota-Blast" Bits

Hughes "ROTA-BLAST" RG-2JS Mining Bit—Instead of conventional teeth, this bit has sintered tungsten carbide inserts combined in a special process with alloy steel cones. They provide maximum resistance to wear in the hardest and most abrasive formations. Inserts in the gage surfaces of the cones reduce gage wear and increase the cutting efficiency of the bit. Inserts on the bit legs eliminate the problem of body wear.

Hughes "ROTA-BLAST" bits – Engineered for Mining

RG-2JS
For extremely hard abrasive rock (Taconite, quartzite)

W7R
For hard rock (Siliceous limestone, dolomite, sandstone, granite)



OW
For medium rock (Limestone, sandstone, sandy shales)

are Engineered for MINING

This is the Hughes "Rota-Blast" RG-2JS rock bit . . . proved superior in the Mesabi Iron Range, toughest of all blast-hole drilling. The RG-2JS rock bit is a direct result of Hughes Tool Company research in co-operation with drill manufacturers and mine operators.

In the extremely hard, abrasive taconite in the Mesabi Iron Range, steel tooth bits drilled from 5 to 20 feet. The RG-2JS "ROTA-BLAST" consistently makes 500 to 800 feet of hole per bit in the same type of rock.

Research that developed the RG-2JS is going into the complete line of "ROTA-BLAST" bits, engineered specifically for rotary blast-hole drilling. The "ROTA-BLAST" line includes a full range of sizes and types.

Your Hughes Representative can recommend the bit that will deliver the best performance in drilling every type of rock. And behind his recommendation and behind every Hughes bit is more than a half-century of rock bit experience plus the world's largest rock bit research laboratory and manufacturing plant.

OSC-1G
For soft formations
(Calcite, shale, clay)

HUGHES
industrial products
Hughes Tool Company · Houston, Texas

Question 1: What is different about Haulpak?

A: The LW Haulpak is like other off-road trucks *only* because it has wheels and an engine! Otherwise, its design is completely different—for your benefit. For instance:

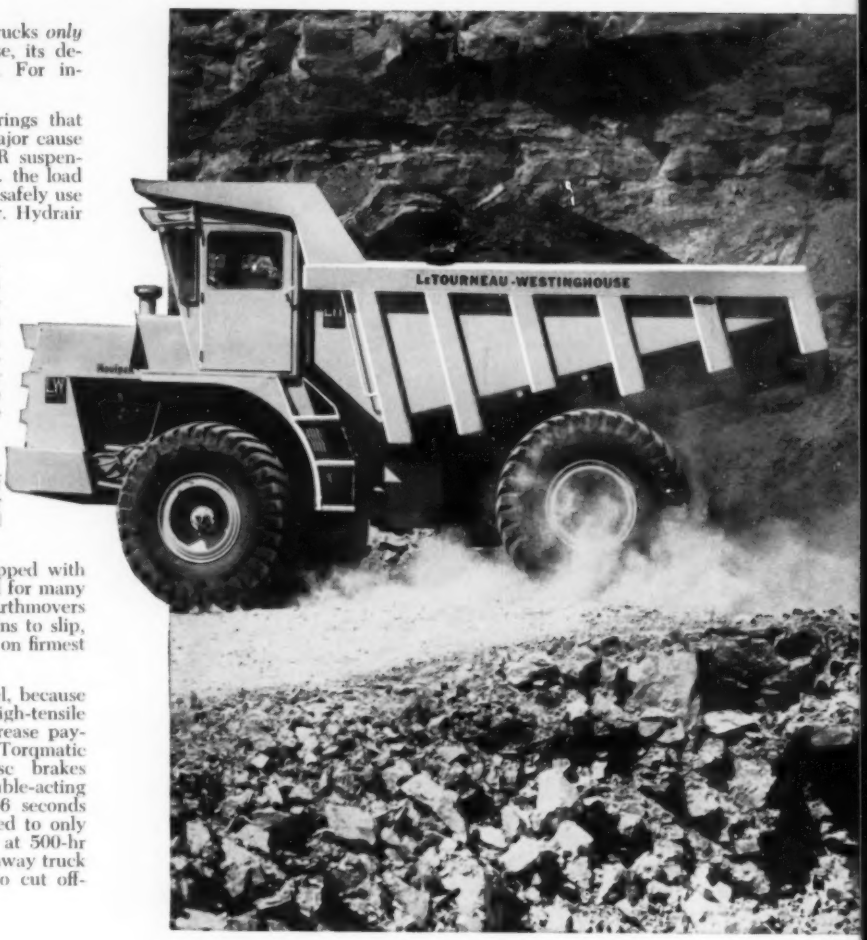
RIDES ON AIR—Other trucks ride on steel springs that need much attention. Haulpak eliminates this major cause of downtime with the exclusive LW HYDRAIR suspension system. With it, Haulpak *rides on air* . . . the load rides smooth and level on rough roads. You can safely use faster hauling speeds, move more tons per hour. Hydrair also make possible many other advantages:

SHORTER TURN RADIUS—Because Hydrair suspension eliminates need for conventional springs and front axles, Haulpak's front wheels can be turned at sharper angles . . . permits U-turns in ⅔ the space required by competitive trucks. And without need for springs and axles, Haulpak can be built with a shorter wheelbase for more efficient transfer of power-to-wheels. There is, however, no loss in load capacity, because you get the LW exclusive . . .

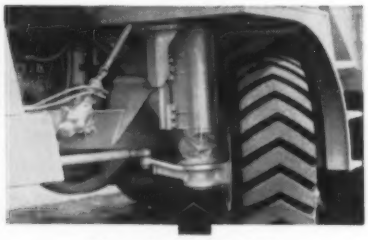
DEEP "V" BODY—This permits carrying about 6 tons of material *below* the normal floor-line of conventional trucks. It also gives you a lower center of gravity, better stability on turns and steep grades.

HAULS THROUGH DEEP MUD—Haulpak is equipped with the famous LW power-transfer differential, used for many years in thousands of heavy-duty Tournapull earthmovers all over the world. When one drive wheel begins to slip, power is transferred automatically to the wheel on firmest footing. Soft going does not stop Haulpak!

MANY OTHER MONEY-SAVERS! You save on fuel, because Haulpak is built of the newest light-weight high-tensile strength steels—to reduce dead-weight and increase payload. Also, Haulpak gives you power-shift Torqmatic transmission, full power-steering, multiple-disc brakes with 5,148 sq in in total braking surface, double-acting hydraulic rams that lift body to 70° tilt in 16 seconds for fast dump. And lubrication check is reduced to only 3 easily-reached fittings needing attention only at 500-hr intervals. Haulpak is not just a "beefed-up" highway truck . . . it is a totally new concept developed to cut off-road hauling costs.



Question 2: How does Haulpak save you money?



Here's HYDRAIR

This sturdy, simple air-hydraulic suspension replaces the usual leaf springs found in conventional off-road equipment, relieving Haulpak owners from expensive spring repair and maintenance. Hydrair cushions against loading and travel shocks, compensates automatically for off-center loading, and keeps the load riding level over bumps and holes and permits faster hauling cycles.

A: "How does Haulpak save you money?" From the answers above you can easily see how this all-new hauler *saves* on hauling costs. Haulpak gives you:

- **greater maneuverability**
- **lower operating cost**
- **lower maintenance**
- **faster hauling**
- **more pay-tons per hour**
- **. . . and bigger profits!**

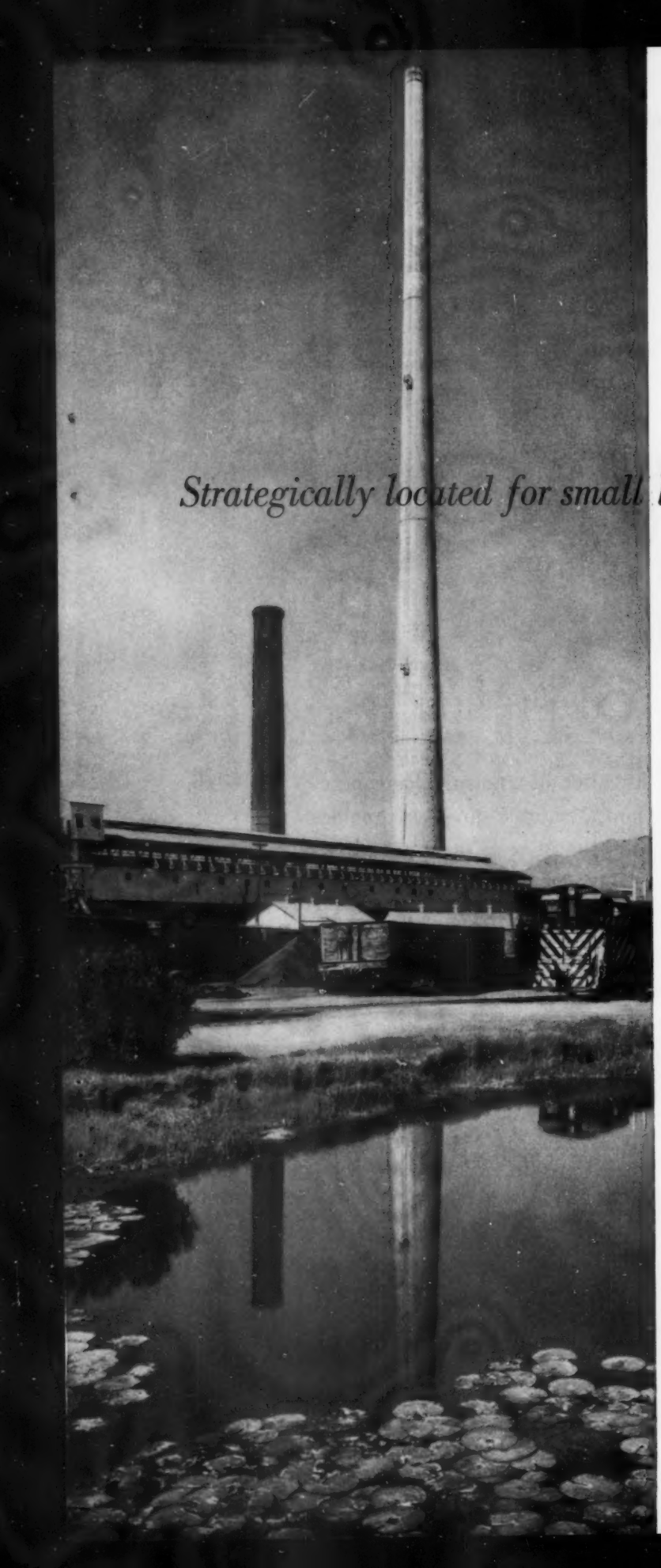
Next time you need an off-road hauler, investigate the LeTourneau-Westinghouse Haulpak. Available in 22, 27, and 32-ton sizes. We will send complete information.

Hydrair—Trademark
Haulpak—Trademark Reg. U.S. Pat. Off.
HP-2261-G-1r

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



See ASARCO first
buying, smelting, and
refining all types of ores:
GOLD, SILVER, LEAD,
COPPER AND ZINC ores
and concentrates, blister
copper, mattes and residues
20 Smelters and Refineries

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LEAD SMELTERS
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East Helena, Montana
El Paso, Texas
Chihuahua, Chih., Mexico
San Luis Potosi, S.L.P., Mexico

ZINC SMELTERS
Amarillo, Texas
Corpus Christi, Texas
Rosita, Coah., Mexico

COPPER SMELTERS
Hayden, Arizona
El Paso, Texas
Tacoma, Washington
San Luis Potosi, S.L.P., Mexico

LEAD REFINERIES
Selby, California
Omaha, Nebraska
Perth Amboy, New Jersey
Monterey, N.L., Mexico

COPPER REFINERIES
Baltimore, Maryland
Perth Amboy, New Jersey
Tacoma, Washington

See management
at above locations
or write to main office.
American Smelting and
Refining Company,
Ore Purchasing Department,
120 Broadway,
New York 5, N. Y.

58-54

ASARCO

at American Zinc Company...

HIGH TONNAGE CONTINUOUS FILTRATION PROBLEM SOLVED WITH OLIVER HORIZONTAL FILTER

Continuous, automatic, high tonnage filtration of zinc sulphide concentrates at the American Zinc Company's plant, Mascot, Tennessee, provides a unique demonstration of the advantages of the Oliver Horizontal Filter.

Feed consisting of 63% solids is from the underflow of a 6″ dia. Dorrclone®, which is used for removal of the fine fraction from the flotation plant concentrates. Leaf tests and a pilot demonstration established the superior capabilities of the Oliver Horizontal Filter. The 6′ dia. filter now installed handles 5½ TPH with capacity to spare. 2½″ thick cake with a final moisture of about 4.5% is continuously removed by a scroll discharge mechanism.

Normally considered for rapid washing and de-watering of coarse, free-settling solids which are difficult to maintain in suspension, the Oliver Horizontal Filter is ideally adapted to the American Zinc Co. type of operation. Horizontal design utilizes gravity and the minimum vacuum for fast production of a thick, easily discharged cake. A wide range of applications is possible. For information, write Dorr-Oliver Incorporated, Stamford, Conn.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

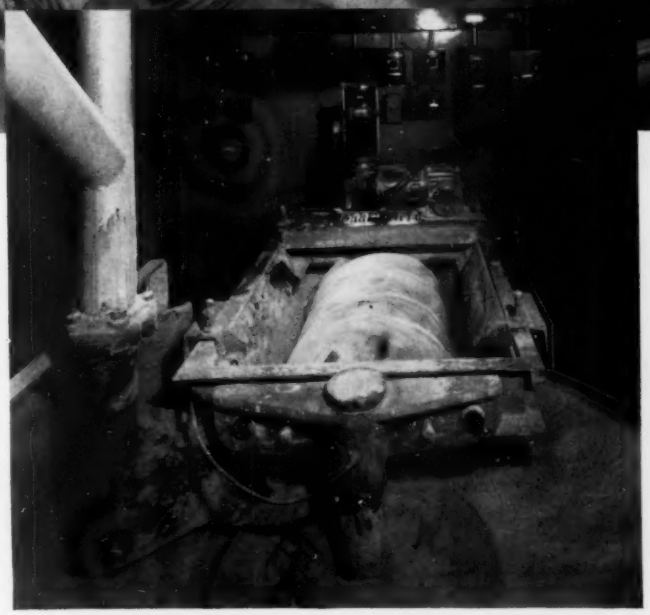
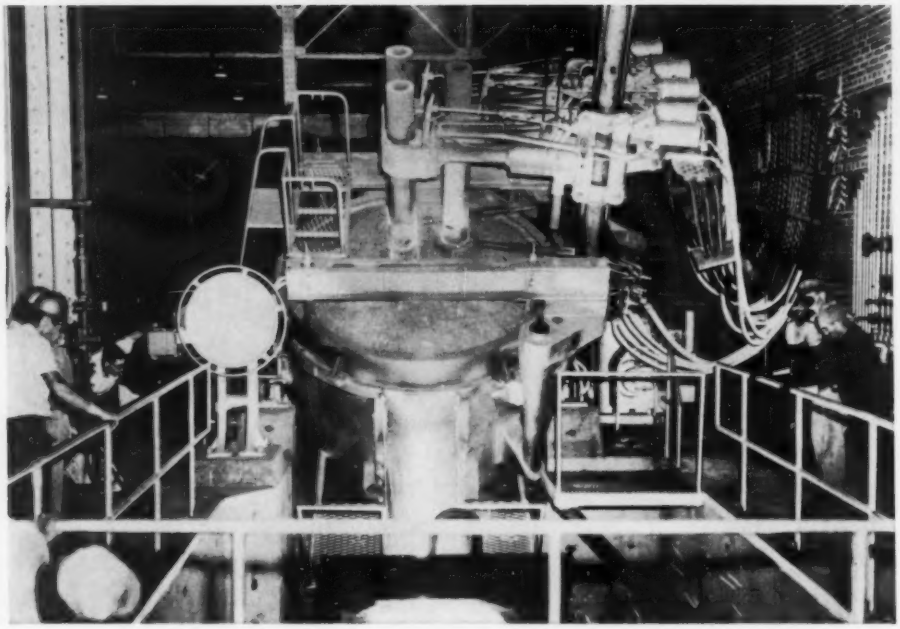


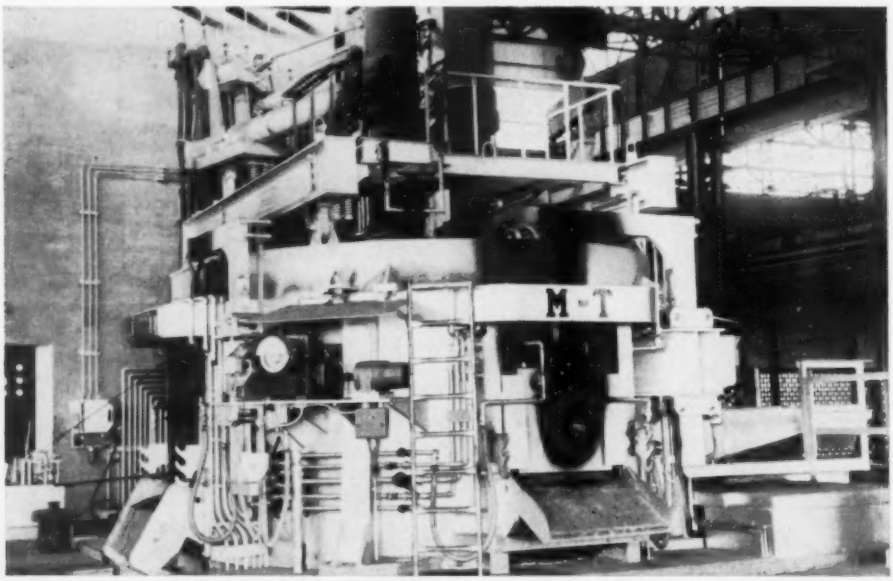
Photo of 6' diameter Oliver Horizontal Filter at American Zinc Co. demonstrates thick cake formation with high moisture removal. Screens are stainless steel mesh and have been in operation for over 10 months. No maintenance has been required. Close-up of scroll discharge mechanism, with control panel in the background, is shown in the smaller photo at right.



When you melt or smelt

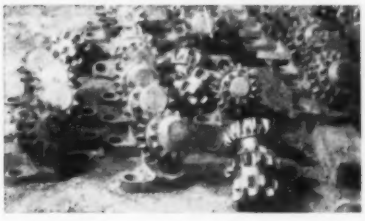
Lectromelt furnaces are available in types and sizes to suit all requirements—for melting steel for ingots and castings, and gray and malleable iron for castings...melting copper and nickel...producing pig iron, ferroalloys, calcium carbide, phosphorus, etc....and smelting ores. For information, or a consultation regarding furnace requirements, write Lectromelt Furnace Division, McGraw-Edison Company, 324 32nd Street, Pittsburgh 30, Pennsylvania.

McGRAW-EDISON



Lectromelt®

Kermac 17 Drills Shaft For U. S. Record



A new United States record for shaft sinking has been set by Kermac Nuclear Fuels Corporation at its Section 17 uranium mine in Ambrosia Lake, New Mexico. An 810-foot-deep, 44-inch diameter, round ventilation and manway escape shaft was drilled from surface and completely lined with ½-inch thick steel casing in only 24 days.

The picture at left shows the No. 17 production shaft and surface plant in the distance while the rotary derrick used for drilling the air shaft dominates the foreground.

Sinking procedure was first to drill a 12¼-inch diameter hole with a Hughes Tri-Cone rock bit to a depth of 838 feet. The extra 28 feet was space for accumulation of "trash" (broken bits, teeth etc.) so as not to interfere with reaming. This pilot hole was drilled in three days. Surveying showed it to be only 30 minutes from vertical.

Next step was reaming to full 44-inch diameter in one pass with a special reaming bit body mounting 12 Hughes rolling shaft cutters in four rings. A total of 60 of these shaft cutters (lower picture) were used in reaming the hole. The reaming bit also mounted a series of roller reamers on its side to maintain hole diameter and primarily to serve as a stabilizer during reaming. From five to seven feet of hole per hour were reamed.

The pilot bit was mounted on the bottom of standard 5⅞-inch drill pipe. This same pipe was used for rotating the reaming bit. A 42-inch hole guide was used to center drill pipe and prevent whipping. Drilling mud was circulated at 1,200 gallons per minute. This resulted in poor flushing and volume will be increased on the next shaft.

A 21-ton, 40-inch outside diameter, ¾-inch steel wall lead-filled drill collar 8 feet, 10 inches, long was mounted just above bit body to give necessary weight to force cutters into the rock. A second collar was available but was not used.

Formations penetrated from the collar were the Mancos shale to a depth of 538 feet, the Dakota sandstone to 612 feet, and the Brushy Basin and Westwater to the bottom.

The Rayco Drilling Company of Farmington, New Mexico contracted drilling and casing the hole. It is the first of four to be drilled by Kermac. With knowledge gained on this first hole new records appear certain to be set on the others.

Electric Truck Speeds Muck Up Berkeley Grade

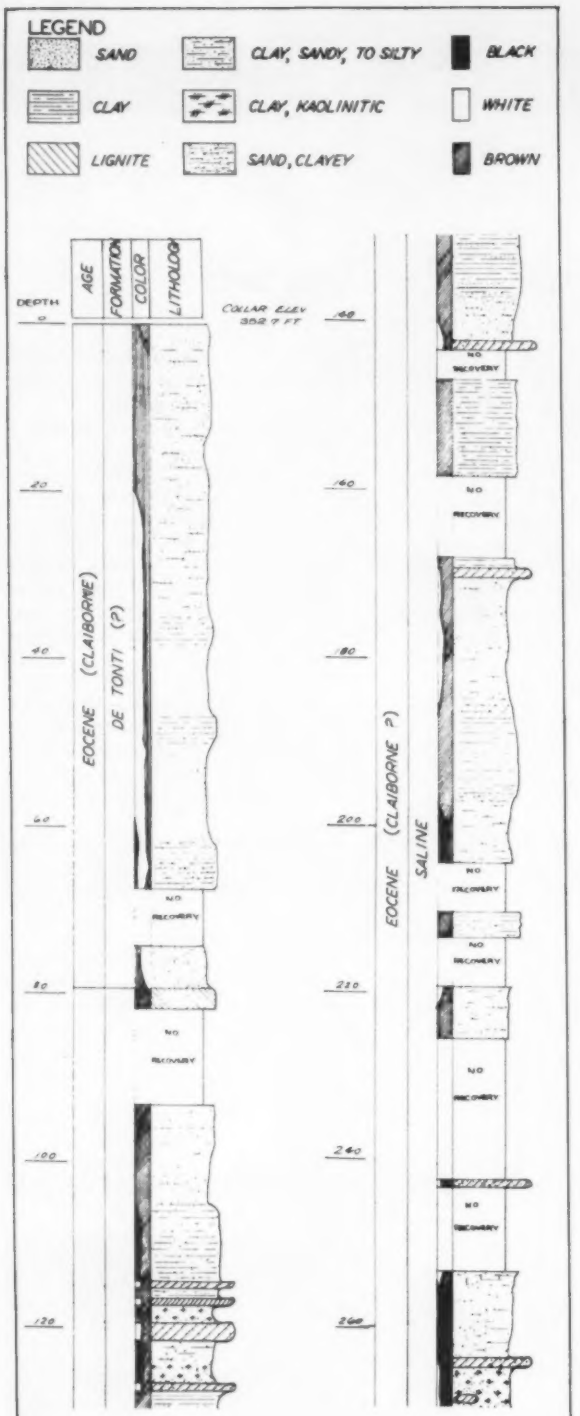
The picture at right shows Anaconda Company's new electric wheel truck hauling a 75-ton waste load out of the Berkeley copper pit at Butte, Montana at a speed of 15 miles per hour.

Of particular interest is the overhead trolley system which supplies direct current to the four 400-horsepower electric motors, one in each wheel. On the return trip the motors act as generators to return power to the system by regenerative braking. Each power pole is supported by a precast concrete slab which is built so that a fork lift truck can pick up the base and pole and quickly transfer it to a new location.

An auxiliary 335-horsepower Cummins Diesel engine, mounted under the cab, provides both alternating and direct current for operation off the trolley. That is, backing under the shovel dipper, moving loads into trolley area, and backing into dump position at disposal area.

This new Trolley Dump was built for Anaconda by R. G. LeTourneau to specifications prepared by the Anaconda research staff headed by E. R. Borcherdt.

The truck has hauled 110 tons on the flat, has a heaped capacity of 60 cubic yards, weighs 62 tons empty, is 41 feet long, and 16 feet 7 inches high. Tire size is 40 inches wide by 89 inches in diameter.



Drill log of the hole showing rock formations penetrated by the rotary drilling rig of Reynolds Mining Company at their bauxite mine in Arkansas.

Rotary Drilling Speeds

by Martin Honke

Reynolds drills three 72-inch

Rotary drilling rather than conventional methods of shaft sinking has proved to be the safest, lowest cost, and most certain method of gaining access to deep deposits of bauxite in central Arkansas.

Reynolds Mining Company recently placed a new underground mine in operation six miles southeast of Bauxite. Three circular shafts with a minimum inside diameter of 72 inches were drilled to depths over 500 feet—a new depth record for the district. The largest district tonnage, by far, is mined from open pits.

Shaft sinking through the unconsolidated water bearing sediments lying over the bauxite deposits has always been a problem in the district. While the generally flat lying ore bodies vary in thickness, grade, and hardness, are all

Rotary drill offers advantages

Detailed study was undertaken to determine what method of sinking the shafts would be the most feasible and economical. Of the many and varied techniques, two methods seemed to be the most advantageous: 1. Freezing the unconsolidated sediments and then sinking by one of the conventional means. 2. Drilling, using the rotary clay seal method.

Historically, shafts in unconsolidated or easily drilled materials have been drilled at a lower cost than conventionally sunk shafts in the same materials. A circular section was chosen because of its inherent strength and low maintenance cost. The inside diameter would be as large as could be considered within economic reason to this depth. The collapse pressure for a cased and grouted shaft is reduced as the diameter is increased. Therefore, to make a safe large diameter shaft, the total required thickness of casing and concrete increases rapidly thus making the cost of a large diameter shaft prohibitive.

Due to the risk involved in the sinking of a single large diameter shaft through unconsolidated materials, it was more economical to sink two shafts of smaller diameter close together. The thickness of the casing, or the liner plate, was determined mainly by past experience under similar drilling conditions.

In terms of safety, the rotary method is better because no one enters the shaft itself until it is completed.

Another factor considered was that many of the existing shafts in the area had successfully been sunk by the rotary methods. However, none of these shafts were to depths over 500 feet. On the final analysis, it was decided that the rotary method would be used.

Arkansas Shaft Sinking

Senior mining engineer, Reynolds Mining Company

shafts to reach bauxite ore

quite impervious to water, and are hard enough so that mine development workings don't have to be timbered, a difficult problem has always been sinking through overlying sediments and sealing a shaft off so that water doesn't get into ore beds.

These overlying water deposited sediments consist of interbedded sands, gravels, occasional lenses of siderite, lignitic sands, clays, and some layers of quicksand.

After ore body discovery and development drilling from surface, Reynold's engineers ascertained that two or three shafts would be needed to efficiently mine the ore body: an auxiliary shaft for men, supplies, and waste hoisting which would serve as a development shaft; one large or two smaller shafts necessary for ore hoisting.

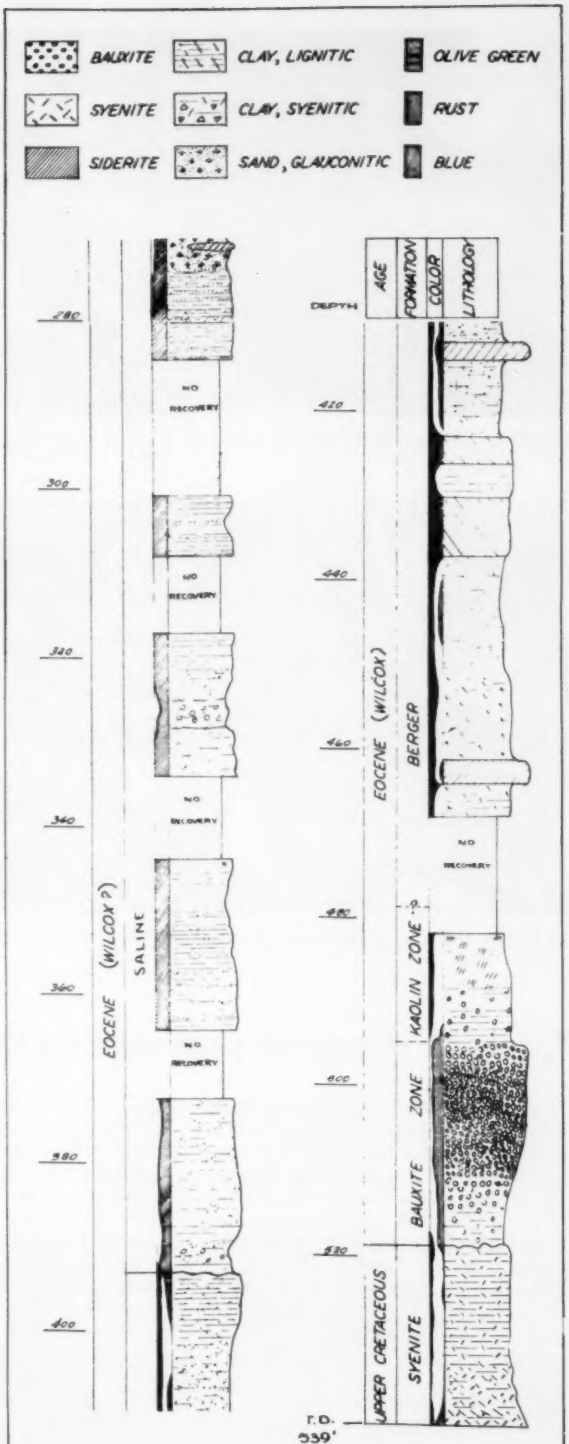
of economy and safety

The proposed shaft sites were test drilled and formations logged with data made available to the contractor before the contract was let. A representative log of a shaft site area test hole is shown. During February, 1956 the contract was let to Layne-Arkansas of Stuttgart, Arkansas, a company not only experienced in drilling, but with an excellent record for the completion of drilled shafts.

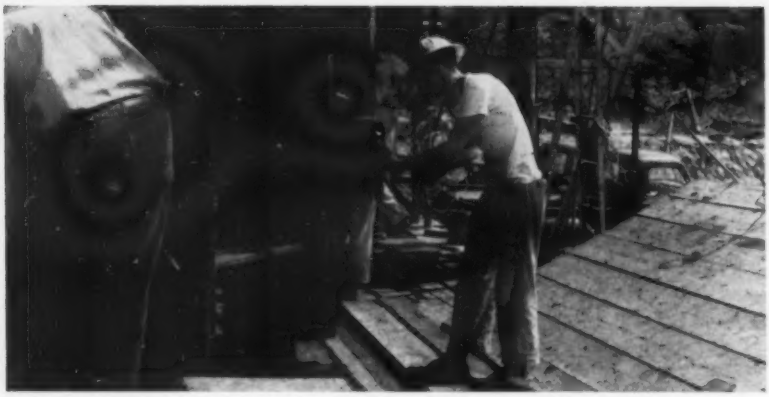
A rotary drilling rig of the oil field variety was used for sinking these shafts. It was a Lee C. Moore (Tulsa, Oklahoma) derrick with a capacity of 437,000 pounds. It was 87 feet high with a 5½-foot crown and 24-foot base built with 6 by 6 by ½-inch angles and 6-inch standard pipes in the corners. The National draw-works used butane for fuel. API, 6⅝-inch, full hole drill rods with a Layne swivel and an American Well and Prospecting Company table were used. Cable was 1⅛-inch in 8 lays to the block.

Contract was for completion of three shafts with a six foot minimum inside diameter to a depth of 500 feet, plus or minus. Work was commenced on the auxiliary shaft in June, 1956. The auxiliary was completed to a depth of 513.5 feet. The other two, the main ore-hoisting shafts, were completed to 509.5 and 525.0 feet respectively. Layne-Arkansas completed all sinking operations and removed its equipment from the property in 23 months.

The auxiliary shaft was designed as an operating shaft for the initial development work. It has a ladderway for emergency exit and a skip which is used for raising and lowering men, timber and supplies, and for hoisting development ore. The two main shafts are located with a center-to-center distance of 16.25 feet, so that balanced hoisting is possible with a single headframe and hoist.



Continuation of drill log from opposite page. Drilling through water-bearing unconsolidated sediments to reach the impervious bauxite required casing and grouting.



AN 82-INCH REAMING BIT is examined prior to positioning in hole.

CLOSE-UP of the 94-inch diameter reaming bit with 20-inch leader for pilot hole.

20-inch pilot hole

After the shaft site was chosen, the derrick was erected. Then a surface seal was formed by hand digging a hole to take 10 to 20 feet of 120 inch inside diameter corrugated liner. The hoist equipment on the drill rig facilitated the removal of this material. The annular space outside the liner was grouted. This surface seal prevented ground failure under the rig, prevented the entry of surface waters, and provided room for the large diameter reaming bit to be positioned under the rotary table.

Two sumps, one for mud, and one for make-up water, were dug near the shaft. A flume with board side walls and paved bottom was built on a sloping gradient between the shaft being drilled and the mud sump. The gradient of this flume is steep enough to prevent the drilling muds from settling, yet is flat enough to prevent eroding the area.

A 6-inch Kansas City Hay Press pump capable of delivering 1,000 to 2,000 gallons per minute was used for the circulation of the muds. An auxiliary mud control pump was also used. The pump fuel was butane with electric power as a standby. A dynamometer was used by the driller to indicate his hook load so that the rate of penetration could be accurately controlled. The bit rotation on large

Cement grouting pumped between steel casing and shaft walls

The shaft casing was of 72-inch inside diameter with a ⅝-inch wall thickness. A dished head (with a reverse threaded 6-inch pipe fitting through the center) was welded to the bottom of the first section of shaft casing, and 6-inch pipe extended to the top of this section. Bowed metal straps were welded at intervals around the outside of the casing to properly center the casing in the drilled hole. The dished and flanged heads, as well as the shaft casing, were fabricated to the specifications of the pressure vessel code.

Lowering or sinking the casing to a convenient level in the hole was caused by filling the casing with controlled mud weighing 9 to 10 pounds per gallon. As the casing was sunk it was lengthened by welding additional sections to the top. The 6 inch pipe was simultaneously extended by threading additional lengths into the lower pipe sections. When the casing reached the bottom of the 82-inch hole, a dished head was welded to the top. The 6 inch pipe was extended through this head and welded into position. Also extending through the head are two 4-inch pipes so that circulation can be maintained inside of the closed casing during pressure and grouting operations. Circulation around casing is started by pumping down the 6-inch center line and allowing the return to the surface around the 72-inch casing.

Grouting was started by pumping a 14-pound-per-gallon cement grout down the 6-inch center line. This grout displaced the mud and forced it upward between the casing and the wall of the hole. When the grout completely filled the void around the lower 100 feet of casing, a packer was forced by water to the bottom of the 6-inch liner and held there by water pressure. Grouting then continued through one of two 2-inch lines that were lowered from surface in the annular ring around the casing. All grouting was done beneath the rising surface of the grout. While one grout line was pumped, the other line was being shortened. When the end of the line that was first shortened became submerged in the rising grout, grouting started through this line while the other line was raised a few feet. This was done so initial set can take place under undisturbed conditions. Grouting continued until it overflowed at the surface. From 2,000 to 3,000 sacks of cement were used for grouting the casing in each shaft. Hydrostatic pressure between 50 and 100 pounds per square inch is maintained inside the casing during grouting operations to prevent internal collapse of the casing. After the grouting is completed and the cement is setting, the pressure inside the casing must be carefully maintained as only a slight change in the temperature of the large volume of liquid contained in the casing will cause large pressure fluctuations. On a warm day with the sun shining on the short portion of the

reamed to 94-inches with special bit

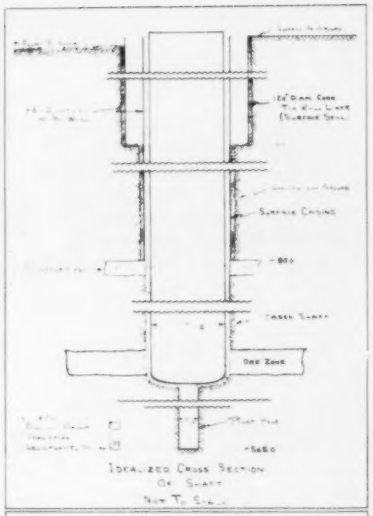
hole drilling was between 20 and 40 revolutions per minute. The mud was controlled at 9 to 10 pounds per gallon with a viscosity of 30 to 35 seconds and a pH of 8.0. Mud serves effectively to support and seal the walls of the hole, to remove the drill cuttings, and to cool and lubricate the bit. "Laynite" clay base mud was controlled using soda ash to maintain the pH, caustic soda to increase the viscosity, phosphate to reduce the viscosity, and baroid for gravity control.

A 20-inch-diameter pilot hole was then drilled to a depth a few tens of feet deeper than the probable shaft depth. This excess depth is for storage of some of the drill cuttings so that the pilot hole does not become "blinded." The pilot hole is drilled at a fairly slow rate of penetration to produce a hole that is as straight and plumb as possible. A long, 4,000 pound, collar was used at the bit to prevent the pilot bit from wobbling in the hole. Drag and tricone bits used to drill the pilot holes were large diameter conventional types. When completed, the pilot holes were surveyed by Eastman Oil Well Survey Company for straightness and plumbness.

Pilot survey results with the final cased shaft location at 500 foot depth are shown. When two shafts are adjacently located, it is very important to be certain that the pilot holes are far enough apart so there will not be any possibility of interference when the two shafts are reamed to full bore. Using the pilot hole as a guide, the hole is reamed to a 94-inch diameter.

At 80-foot depth a layer of poorly consolidated sandstone was used as the bottom seal area for the surface casing. This casing with an inside diameter of 82 inches and a wall thickness of ⅝ inch prevents ground water circulation into the shaft. This casing was centered in the 94-inch hole and grouted into place.

Drilling was resumed to the desired depth using an 82-inch diameter bit. To keep the drill rods centered in the 82-inch hole when drilling at depth, guides were placed at intervals on the drill rod to keep it straight and prevent whipping. The swivel pressure was maintained at 20 to 25 pounds per square inch. A type of reaming bit used is pictured. The 30,000-pound drill collar was used with the large bits. Tips of the cutting surfaces of these large diameter reaming bits were built up of hard surfacing material. Later, another bit (see picture), using continuous miner bits with carbide inserts as the cutting tools was used.



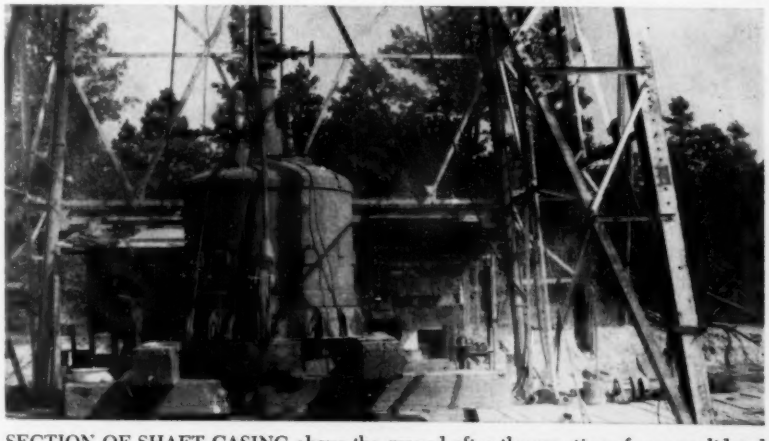
under hydrostatic pressure prevents internal collapse

casing above the ground level, the pressure will start a steady, rapid rise. On cold nights, the pressure will drop. It is possible that these changes of pressure could cause the casing to rupture, or cause weakening of the newly placed cement grout.

After the cement has properly aged, the pressure inside the casing is released and the dished head and the casing above the surface level is removed. The center 6-inch pipe is then disconnected from the stub at the bottom of the casing and removed from the shaft. A 70-inch outside diameter template is then run to the bottom of the casing to be certain that the casing is in satisfactory condition. The liquid inside the casing is pumped out and the inside of the shaft can be inspected. The shaft is then ready to be fitted as a mine shaft.

It is believed that this method, with innovations, could be adapted to other locations with a resulting savings over the cost of conventionally sunk shafts.

The writer wishes to acknowledge the kind permission given by R. H. Zeglin, vice president and general manager of Reynolds Mining Corporation, to publish this paper. He also wishes to acknowledge the assistance given by the personnel of the Layne-Arkansas Company. END



SECTION OF SHAFT CASING above the ground after the grouting of unconsolidated beds in depth has been completed, and before the pressure head was removed.

Automatic Grinding Circuit Control

by Norman Weiss

The rapid advancement of automatic control in flotation concentrators becomes apparent when we take even a cursory look at the mills designed only 10 years ago, and then consider the plants just completed and the face-lifting that is taking place in the older ones. Literally overnight, manufacturers of components and systems on the one hand, and mine managers and operators on the other, have come to realize that here is a field worth tilling, and the two are finding mutual advantage in an exchange of knowledge.

To many of the latter group the millenium of a push-button mill seems within reach, but the economic balance between desirability and cost has to be examined with care and foresight. Even the largest mining companies, who have the wherewithal to study control methods in just one section, or just one mill, and then apply the benefits to all the others, cannot afford to buy costly instruments without a reasonable chance of success. "What is to be gained by automatic measurement and control, when you're already running your mill with just a handful of men and your recoveries and concentrate grades are nearly tops." It's a reasonable question.

We realize that automation of a flotation mill—to be successful—must be a single, integrated system, rather than a sporadic or spotty addition of instruments and gadgets. But we must start somewhere, and today the intense interest in automatic control of grinding circuits indicates that the battle between rising costs and declining grades of ore will be joined right here. This is a logical place to start, because optimization of the milling rate is the best way to reduce costs, and this can be done economically and most efficiently only by the application of automatic controls.

Millmen know that the best indication of underload or overload of a bill mill circuit is the circulating load, expressed either as percentage of new feed or directly in tonnage rate. One of the oldest methods of measuring this load in a rake-type classifier was to measure its depth on

1. "Water Balance" holds grinding mill density constant;

In the conventional arrangement of a rod mill followed by one or two ball mills, in which the former works in open circuit and the latter in closed circuit with a classifier, the quantity of circulating load on the ball mill indicates, better than any other parameter, whether the feed rate might be increased to obtain lower cost, or ought to be reduced to obtain a better recovery. Since ball mills work most efficiently with circulating loads in the range of 200 to 400 percent, an increase in the total tonnage issuing from a ball mill most likely reflects an increase in tonnage of circulating load, and only in a much smaller degree an increase in tonnage of new feed. Consequently, the ball mill discharge is nearly as dependable as the circulating load for controlling feed tonnage.

The weight of the ball mill discharge is equally or more difficult to obtain than the weight of the circulating load—either involves costly instruments. On the other hand, the density of the ball mill discharge is not a good parameter in itself.

The "water balance" control is essentially simple. If the density of the ball mill discharge is measured, and **held constant** by automatically increasing or decreasing the quantity of water added to the ball mill scoop box, then the quantity of water added at that point will be an indication of the total solids tonnage and an approximate measure of the circulating load tonnage, and it can be measured by a low-cost flowmeter such as a rotameter or orifice, equipped with a magnetic or pneumatic transmitter. In simple terms, an increase in water at the scoop box would indicate a higher circulating load, the control would effect a reduction in tonnage rate, and conversely a drop in water quantity would indicate a lower circulating load, causing the control to demand an increase in tonnage rate.

Feed rate to the rod mill would be controlled by a weighing device, of which the controller index is equipped with a pneumatic set point. Through a ratio and inverting device the signal from the flow meter in the water line is connected to the scale, so that a smaller signal (less flow) positions the control index of the scale at a higher point, and vice versa. A ratio device makes it possible to establish the best response on the basis of experience.

The "water balance" method of control is applicable to

What is Automatic Control?

The ultimate objective of automatic control and automation in milling is to obtain the economic maximum value from the ore by the use of mechanical aids that surpass on-the-spot human judgment. They will accomplish this by making the most economic grade of concentrate and recovery of metal compatible with the nature of the ore, taking into consideration costs, prices, and smelter schedule. They will maintain maximum milling rate consistent with this result, and constantly adjust water dilution, fineness of grinding, volume of pulp, reagent dosages, and many other process variables as the need arises. They will do all of these things, and more—some day.

by "Water Balance" and "Delta-T"

Chief milling engineer, American Smelting and Refining Company, Salt Lake City, Utah

the first rake blade; another was to relate the load to the ammeter reading of the classifier motor. Indirectly the circulating load could be derived from the total load (the ball mill discharge) by measuring the power used by an elevator or pump that transported this pulp back to the classifier or screens. These methods were not reliable, nor readily adaptable to automatic control of the feed.

The acceptance of the hydrocyclone in flotation concentrators in this country a few years ago led to new efforts to measure the circulating load on a ball mill, and to use this intelligence to regulate the ore feed rate to the primary mill. Some of the methods now under intensive study by leading mining companies include actual weighing of the underflow of hydrocyclones, employment of mass flow meters, and non-contacting radioactive isotope devices. Some measure the density of the cyclone-spigot discharge-pulp by bubble tubes, displacers, or isotope meters, and use this intelligence to control the ore-feeding device. Others measure the circulating load indirectly, by using a constant amount of water to the ball mill, and measuring the density of the ball mill discharge pulp to indicate an increase or decrease in circulating load. Others measure the total power or the sound level of the system.

It is safe to say that none of these methods or any combination of them has been completely successful. Work to develop better and more economical systems is now proceeding in nearly every major concentrator in the United States, and the major manufacturers of instruments and designers of systems are rapidly acquiring a profound comprehension of the millman's problem.

In recent design work on Asarco's Mission copper concentrator, now building near Tucson, Arizona, we happened upon two new and simple methods of optimizing a grinding circuit on the basis of circulating load, and while it cannot be said that these are mature systems, seasoned by full-scale experimentation, they are provocative. These methods, described below, have been named the "Water Balance" and the "Delta-T", or "Thermal", method.

measures water added to control grinding rate

a single stage circuit as well (see diagram); in other words, where dry ore is fed to a ball mill in closed circuit with a hydrocyclone, mechanical classifier, or screen, the density of the ball mill discharge is **held constant** at a predetermined point by automatically increasing or decreasing the quantity of water going to the scoop box. Measurement of this quantity of water changes the set point on the weighing controller, thus causing the feeder to deliver more ore, or less ore, as the case may be. An increase in circulating load causes an increase in the weight of ball mill discharge; to maintain constant pulp density the quantity of water to the scoop box increases accordingly, and this in turn, by means of the ratio and inverting device, causes less ore to be fed to the mill.

Example:

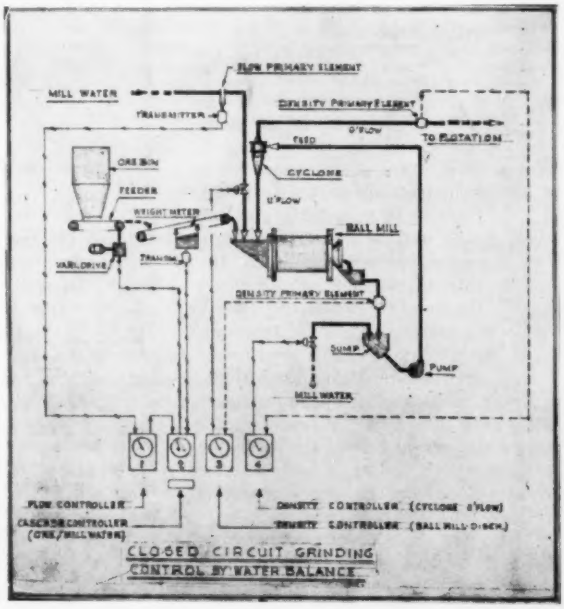
Assume optimum ore feed to ball mill–	100 tons per hour ore
Assume optimum circulating load–	250 tons per hour ore
Then discharge of ball mill–	350 tons per hour ore

Assume optimum density in ball mill is equivalent to 70 percent solids, so that the pulp consists of 350 tons per hour ore and 150 tons per hour water, or 500 total.

Now, because of increased ore hardness, suppose the circulating load begins to increase, and reaches 270 tons per hour ore. Now the discharge of the mill becomes 370 tons per hour ore, which at 70 percent solids (held constant) requires 158 tons per hour of water. The flow meter senses this increase and transmits the intelligence to the weigher, which responds by **reducing** the ore feed rate to the extent dictated by experience. Conversely, a drop in circulating load calls for an increase in feed rate.

In a two-stage grinding circuit it is possible that when milling soft ore the second stage (the ball mills) might conceivably signal for more ore than the rod mill could handle, and against this contingency a manual stop should be placed on the feed control index.

This "water balance" method of control of a grinding circuit to optimize feed rate appears promising. Its simplicity and relatively low cost are notable advantages.



2. "Delta-T" is the temperature differential between the new

When energy is applied to the job of grinding ore in a rod or ball mill the input includes the following:

1. Energy as heat of new ore and water.
2. Energy added by exothermic reactions.
3. Electric energy to motors.

This energy is accounted for as follows:

1. Heat absorbed by transient air and pulp.
2. Heat radiated from external surfaces.
3. Heat lost by motor.
4. Power consumed in mechanical transmission.
5. Heat absorbed by endothermic reactions.
6. Power used in useful work.

Under steady state conditions nearly all of the electrical energy is converted to heat, and most of this is absorbed by the pulp coursing through the mill. For the purpose of this discussion only this part of the heat will be considered, and we will assume that (1) the power consumed by a rotating mill with normal steel charge and constant density is constant, not **significantly** affected by normal variations in tonnage of ore or circulating load; (2) that the quantity of heat made available for heating the pulp as it courses through a specific rod or ball mill is approximately constant. On these assumptions we may draw the following inferences:

a. The rise in pulp temperature within the mill will be inversely proportional to the heat capacity of the pulp (a total of the product of tonnage rates of ore and liquid **times** the specific heats).

b. If dilution of water to ore is held constant in the ball mill, the rise in temperature of the pulp will be approximately inversely proportional to the rate of passage of ore alone (including circulating load). Consequently, this temperature rise may be a good measure of circulating load alone.

These considerations lead to many interesting inferences, not only promising a sound and economical basis for controlling a grinding circuit, but for hydrocyclone and process circuits as well.

The rise in pulp temperature through a mill, from feed to discharge, presupposes that the **temperature of the feed pulp** can be readily obtained, but in some layouts this would be quite difficult in practice, and therefore the precise meaning of "Delta-T" in this particular application is the difference in temperature between the **new water** and the **mill discharge pulp,** both easy to obtain in a single instrument. In other cases, described later, where the temperature of entering pulp is easy to obtain, "Delta-T" will have the more direct meaning.

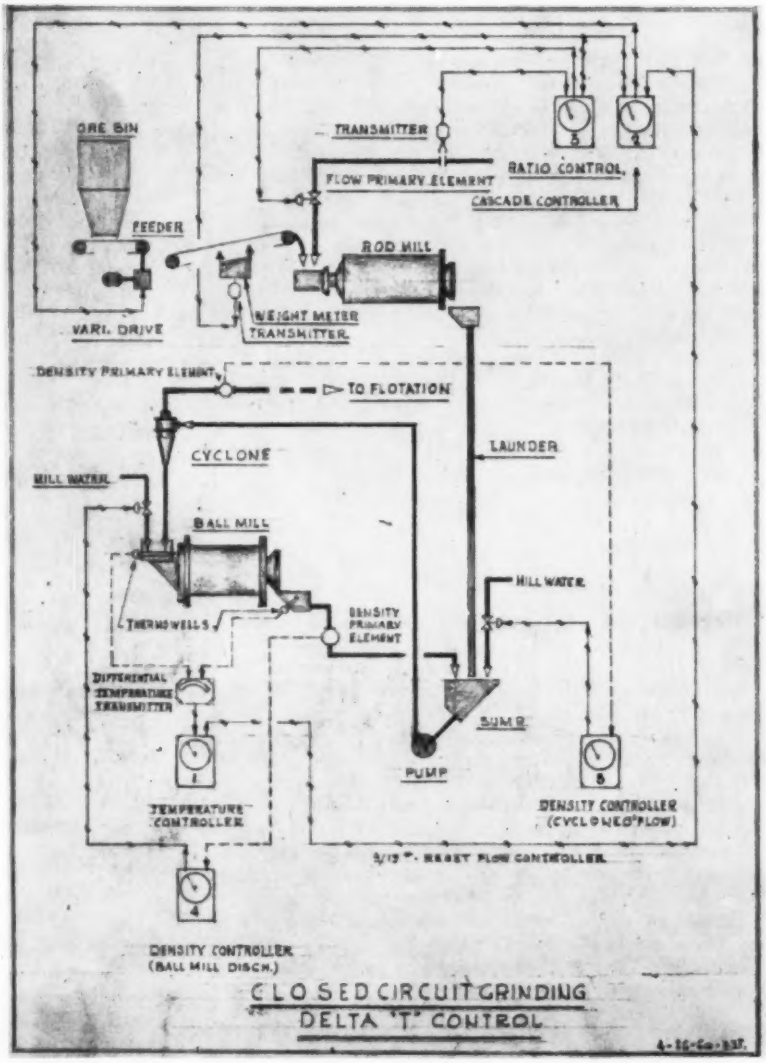


Table No. 1 gives some data gathered on March 22, 1960, at the No. 2 ball mill of the Silver Bell, Arizona concentrator of American Smelting Refining Company. This mill was grinding ¾ inch ore in closed circuit with hydrocyclones for flotation, operating under the "level-density" automatic control system described by Russell Salter, mill superintendent, in a paper presented before the Arizona Section of AIME, Tucson, December 7, 1959. This is a 10.5 by 12.0 foot grate-discharge ball mill, and at the time of test was operating with approximately 350 percent circulating load. It is driven by a 900 horsepower motor and was drawing about 850.

From figures in Table No. I it ap-

water and the discharge pulp to set ore feed rate to mill

pears that this Silver Bell ball mill adds 32,240 BTU's per minute to the potential of the pulp, and it is reasonably safe to assume that this figure is typical for this ball mill, and not likely to change by virtue of a change in circulating load. From this set of figures $\triangle T$ would be the measured difference in temperature between the **new water** and the **discharge pulp,** or 7.2° F.

If the ore were to become harder so that circulating load increased to 400 percent, the calculation can be verified that the ball mill discharge would then measure 84.5° F. instead of 85° F., and $\triangle T$ would be 6.7° instead of 7.2° F. This drop would be sensed by a Differential Temperature Controller, which would transmit a signal to the ore weigher, adjusting its set point to **feed less ore.** Conversely, if the ore became softer, the $\triangle T$ would increase and call for more ore.

This Delta-T method of control appears to hold promise because of its simplicity, accuracy, and low instrumentation cost. The Silver Bell data show a temperature range of less than 10° F., and the Differential Temperature Controllers available as standard equipment ought to respond to 1.0 percent of full scale—in this case, 0.1° F. Even with a 20° scale it should be possible to hold temperature rise within 0.2° F. of the optimum.

Two shortcomings of this method of feed-rate control may come to mind. First, a change in specific heat of the ore may tend to reduce accuracy, but this is not of much consequence.

Second, it will have been noted that the two parameters, "percentage solids" and "pulp density" are not synonymous unless the specific gravity of the ore holds constant. Unfortunately this is not always the case. For example, in the new Mission mine the ore from various sections of the pit will vary from 2.7 to 3.4. This variation is sufficient (if it occurs over a short term) to case doubt upon the value of either the "Water Balance" or the "Delta-T" methods I have suggested in this article, or, in fact, of many methods now in use. However, where such is the case a very simple solution exists in a two-stage system. If a rod mill-ball circuit is employed, the former in open circuit (see "Delta-T" diagram) the addition of water to the rod mill can be ratio-controlled from the ore weigher through a controller and actuated valve, so that for every ton of ore there will be added a known weight of water. For example, if we want to operate the rod mill in a 1:2 pulp (66.7 percent solids), the measure of **density** of the rod mill discharge will be a measure also of the specific gravity of the ore, and this intelligence may be utilized, perhaps, to change the index on the ball mill **density** control so that it will represent **true dilution** despite any ore change. This method can be used on either the water or Thermal system of control.

Once this has been done, further extensions of these methods to control cyclone overflow dilution, or even process dilutions, may be subjected to the same correction. One example is the control of the hydrocyclone. If the ball mill discharge at a fixed temperature and dilution is combined with the rod mill discharge, also at a fixed dilution, and new water is added at the pump which feeds the cyclones, the temperature rise, or "Delta-T" of the pulp feeding cyclone, should depend upon the proportions in which new water, rod mill pulp, and ball mill pulp occur in the mixture—the more circulating load on the ball mill the more dilution water is needed at the feed end of the mill to maintain constant density, and the lower will be the "Delta-T," or temperature differential between new water and mixed pulp. A drop in differential will cause a drop in feed rate. In this example, **density** and **dilution** (percent solids) must be correlated as explained in the preceding paragraph.

With this system the temperature curve of the cyclone overflow will be roughly parallel to that of the new water. However, if it is found desirable to control volume of pulp to flotation by further dilution beyond the cyclone, the "Delta-T" control may be found useful in this application as well.

It is hoped that this article will encourage investigation of the two control methods I have suggested. The water-balance method is simple and relatively inexpensive; the thermal, or Delta-T, method gives promise of being both of these, and in addition it lends itself to more complete integration of control than we have witnessed to date. Whether the methods described will actually accomplish what they are supposed to do is a matter for experimentation and experience to determine. END

TABLE NO. I

Silver Bell, Arizona No. 2 Ball Mill Grinding Circuit Data

Hour	Temperature Deg. F. Feed water	Discharge pulp	Cyclone overflow	Cyclone underflow	Feed tons per hour	Percent solids mill discharge (by density)
2:05	77	85	83	83	97	75
2:25	78	85	83	83	97	78
2:45	77	85	82	82	93	77
3:05	78	85	82	82	99	77
3:25	78	85	82	82	97	76
3:45	78	85	82	82	99	76
4:05	77	85	82	82	97	76
4:25	78	85	82	82	95	75
4:45	78	85	82	82	95	75
5:05	78	85	82	82	96	74
5:25	78	85	82	82	91	75
5:45	78	85	82	82	93	75
AVERAGES	77.8	85.0	82.2	82.2	95.8 (3,200 pounds per minute)	75.8

Assumiug the temperature of ore as 75.5° F., 0.2 as the specific heat of the ore, and knowing from previous tests that percent solids in the circulating load is 78.5 we obtain the following figures for the ball mill:

Component		BTU's per minute
Ore: 3,200 (85.0-75.0) x 0.2	=	6,400
Circulating load: 11,200 (85.0-82.2) x 0.2	=	6,270
Circulating load water: 11,200 x 0.27 (85.0-82.2)	=	8,590
New water: [(14,400 x 0.32) - (11,200 x 0.27)] (85.0-77.8)	=	10,980
		32,240

The Metallurgical Problems . . .

▶ The standard pyrite depressant in copper flotation is sodium cyanide with lime. Buenavista did not want to use cyanide—even in very small quantities. The danger that some farmer's cow might get poisoned from the creek water below the mill, or that some child might get poisoned was too great. The political repurcussions that could arise from such an accident had to be considered.

▶ Microscopic tests soon found an intergrowth of chalcopyrite and pyrite down to micron sizes. Grinding, therefore, would have to be at least 75 to 85 percent minus-200-mesh, and would be better if still finer to set the minerals free.

▶ The fresh ore oxidized very rapidly. The pulp became markedly acidic while grinding and floating in a few minutes in the laboratory.

▶ Even the freshest ore from the deepest parts of the open pit mine carried from 0.05 to 0.8 percent soluble copper as copper sulphate. By grinding the ore in the ball mill (with lime or without lime) the soluble copper so activated the pyrite that it could not be depressed without depressing the chalcopyrite at the same time. One laboratory reported only 9.0 percent copper concentrate after seven cleanings with very high tailing—3.0 percent or more copper.

At first, the only solution to the metallurgical problem seemed to be to wash out the soluble copper between the coarse crushing plant and the ball mill. This would necessitate washing a highly acidic and corrosive ore with the following expensive equipment made of stainless steel: Thickeners to handle the fines and slimes; and dewatering equipment to get the excess water out of the grinding and flotation circuits. Finally a tin can plant (scrap iron) would be needed to precipitate the copper in the wash water as cement copper. These installations would double the cost of the plant and add materially to daily milling costs.

How A Difficult Chalcopyrite-Pyrite Separation Was Made By Flotation

by William Rogers Wade

In 1957 the Cuban company, Cia. Minera Buenavista S.A., began diamond drilling a heavy iron gossan at a place located about 45 miles west of Havana and about eight miles inland from the Port of Bahia Honda, Province of Pinar Del Rio. This gossan had been mined previously and shipped as high grade iron ore.

A series of diamond drill holes were put down under the direction of Sr. Eduardo I. Montoulieu, a Cuban mining engineer and Harvard graduate, in association with Mr. Tom Osborne, a Canadian geologist. These holes were very successful and revealed an underlying ore body, of several millions of tons averaging 5.5 percent copper, with a maximum width of 300 feet between walls. The ore is massive sulphide (solid pyrite and chalcopyrite) assaying 48 to 50 percent sulphur and only 3.0 percent insoluble. The capping of iron oxide over the ore proved to be only a few feet thick making the deposit ideal for open pit mining.

OPEN PIT MINING of copper ore starts right at the grass roots as there are only a few feet of bleached and oxidized capping to strip.

Previous to the discovery of this ore body, Cia Minera Buenavista's partners, St. Daiz de Villegas, Sr. Molé, and Sr. Montoulieu, had operated a pyrite mine east of Havana near Matanzas. This pyrite contained a minor amount of copper; about one half a million tons was shipped to Germany where it was burned to make sulphuric acid. The copper was leached from the cinder and the leached cinder was then smelted to produce pig iron.

Mr. Wade is a consulting mining engineer with headquarters in Marysville, Montana. He is consultant to Cia Minera Buenavista, S. A. with headquarters in Havana, Cuba.

. . . Solved By Reagent Changes

▶ Instead of sodium cyanide and lime to depress the pyrite sodium sulphite (Na_2SO_3) was used with lime.

▶ A larger ball mill was used than originally planned so as to have the necessary capacity for fine grinding in closed circuit with a large duplex classifier.

▶ The acidic pulp formed during grinding was accurately controlled by maintaining a pH of 11.5 which tests showed was most advantageous for flotation. Samplers and pH indicators were installed at the conditioner and the cleaner flotation cells to give a continuous pH reading. The flotation operator was thus able to regulate feed rate of lime slurry to the circuit to hold pH right at 11.5.

▶ The greatest problem was the soluble copper and the great activity it set up in the pyrite. This was so great that the pyrite could only be depressed with such an excess of depressant that the copper was depressed also and went into the tailing with the pyrite. If the copper floated, the grade of the concentrate was so low, because of the excess pyrite, that it was not commercial. For a long time, washing the ore after crushing, but before reaching the ball mill, seemed the only possible solution.

▶ The problem was solved by adding sodium sulphide (Na_2S) to the ball mill scoop as a 20 percent solution. The amount of sodium sulphide, theoretically needed, is a little over 0.8 of a pound per pound of soluble copper. It was found in practice that double this amount 2.0 pounds per pound of soluble copper was advantageous. The extra sodium sulphide acted as a pyrite depressant. In the laboratory Na_2S precipitated black sulphide of copper which floated perfectly and rapidly, as it did later in the mill.

Thus was saved several hundred thousand dollars of additional capital plant investment plus the extra continuous operating expense.

The soluble copper in the ore now went into the concentrate as a very high grade copper sulphide which helped raise the concentrate grade by a small percentage.

▶ It takes about $0.08 worth of sodium sulphide to recover a pound of copper worth $0.30. As a bonus any excess sodium sulphide takes the place of sodium sulphite as a depressant for the pyrite. The sodium sulphite costs nearly as much per pound laid down in Cuba as does the sodium sulphide. Recovering the soluble copper by precipitation on tin can scrap would take 2.5, or more, pounds of tin cans per pound of copper. This would cost $0.12 for the cans per pound of copper in Cuba. To say nothing of the labor costs and capital to be written off during the time this oxidized or partly oxidized ore under the capping was milled. As the mine grows deeper the soluble copper is decreasing and eventually will give no trouble.

The German chemical company paid for the copper in the ore as well as for the sulphur.

Cia. Minera Buenavista stripped this newly discovered ore body and started shipping it to Germany in 5,000-ton lots. Then a strange thing happened. The ore was too rich to ship. The Germans said the high copper content upset their leaching plant which was geared for 2.0 to 3.0 percent copper ore. They would pay for all copper between 0.8 and 3.0 percent, but would penalize all copper over 3.0 percent. As Buenavista was then mining the ore just under the capping there was some secondary enrichment with the result that several ship loads ran 7.0 to 8.0 percent copper. Instead of receiving payment for this high grade ore it was penalized. Thus, it became necessary to remove this extra copper from the ore, and then use the tailing for sulphur.

The ore has so little silica that when the chalopyrite is removed the tailing which is almost pure pyrite has a higher percentage of sulphur than before milling. This is because chalcopyrite is about 35 percent sulphur while pyrite will assay 51 or 52 percent. Therefore, by concentrating the ore by flotation a copper concentrate could be made and sold to a copper smelter and the tailing still used for its sulphur content.

The author was called in to work out the metallurgy of the chalcopyrite pyrite separation and to design and supervise the construction of the necessary milling plant.

Samples of ore were sent for flotation research tests to three private laboratories as well as in the Cuban equivalent of the U.S. Bureau of Mines.

MILL CONSTRUCTION was speeded by using prefabricated steel framing and heavy equipment to place machinery. Walls are concrete block and transite.

POWER HOUSE adjoins mill. Three Caterpillar Diesel electric generating sets supply 1,475 horsepower for mill.

ORE FACE is part of a 300-foot-wide lense where mining started. Ore from this bench assayed 7.5 percent copper.

Flotation concentrates cleaned once

Ore is delivered to the primary crushing plant by trucks from the mine which is less than 1,000 yards distant. From the primary crushing plant it is carried by conveyor belts to the main crushed ore bin.

The steel and concrete block mill building houses an 8 by 7-foot ball mill in closed circuit with an 8 by 26-foot heavy duty rake classifier. A large conditioner, mechanically driven uniform flow pulp distributor, four 6-cell flotation machines, a 30-foot thickener, the six-disc, 8.5-foot-diameter filter, and minor equipment. All machines have individual electric motors. A building holds 8,000 tons of concentrate. There are 18 rougher flotation cells and six cleaners. Middlings from the cleaners are pumped back to the ball mill. Copper concentrate, in lots of 5,000 or more tons, is shipped through the Panama Canal to Japan. An average of 5,000 tons of pyrite is shipped to Germany monthly for its sulphur content which is used to make sulphuric acid.

The mill power plant is Diesel electric with two 550 horsepower engines directly connected to 440-volt, 3-phase, 60-cycle generators, and one 375 horsepower Diesel directly connected to a generator. This diesel electric plant adjoins the mill building, the 440-volt current is carried into the mill in armored lead cable. END

Massive sulphide ore under gossan

The country rock consists of a volcanic complex with serpentine intrusions. Extensive shearing was followed by mineralization. There are three mineralized hills along the shear zone; each capped by a gossan. The ore body being mined now is in the easternmost hill. Diamond drilling has proved considerable ore in the central hill; the western hill is being drilled.

These bodies are massive sulphide with only about 3.0 percent insoluble silica. The copper and sulphur have been leached from the outcrops leaving only iron oxides. There is little or none of the customary copper oxide or copper carbonate left in the outcrops as the large amount of sulphuric acid caused by the oxidation of the pyrite has completely removed the copper. Below these iron gossans, in places, occurs a bleached zone of a few feet vertical extent under which the massive sulphide ore occurs. There is a little secondary enrichment of copper (chalcocite and covellite) near the top of this sulphide zone. This enrichment raises the ore grade at times to 10 percent copper. The ore bodies are lenticular masses; the largest of which as so far known is about 300 feet wide between walls. It has an average grade of 5.5 percent copper for some 1,000,000 tons, or more, plus considerable tonnage of lower grade. Sulphur content is around 48 percent.

The ore is mesothermal with the ore bodies repeating themselves along the strike. There should be several thousand feet of vertical range with re-occurring lenses below each other in the shear zone.

Minas de Matahambre has been producing copper for 45 years, or more, from similar ore bodies with considerably less pyrite which reached a depth of several thousand feet. Matahambre is also in Pinar del Rio about 60 miles west of Buenavista. It will be some years before Buenavista has exhausted its open pit ore and will have to go underground. END

Cia. Minera Buenavista Metallurgical Data

Product	Tonnage daily	Copper percent
Head	401	5.51 (0.06 soluble)
Concentrate	88	20.44
Tailing	313	1.29

Recovery, 81.73 percent of copper with ratio of concentration of 4.54 to 1.0.

Reagent consumption in pounds per ton of ore milled: Lime, 14.0; Na_2S, 1.9; Na_2SO_3, 1.9; Z5, 0.1; Z6, 0.2; and Dow 250, 0.2.

Operating Densities

Measuring Point	Density
Ball Mill overflow	2,600
Classifier overflow	1,230
Conditioner overflow	1,220

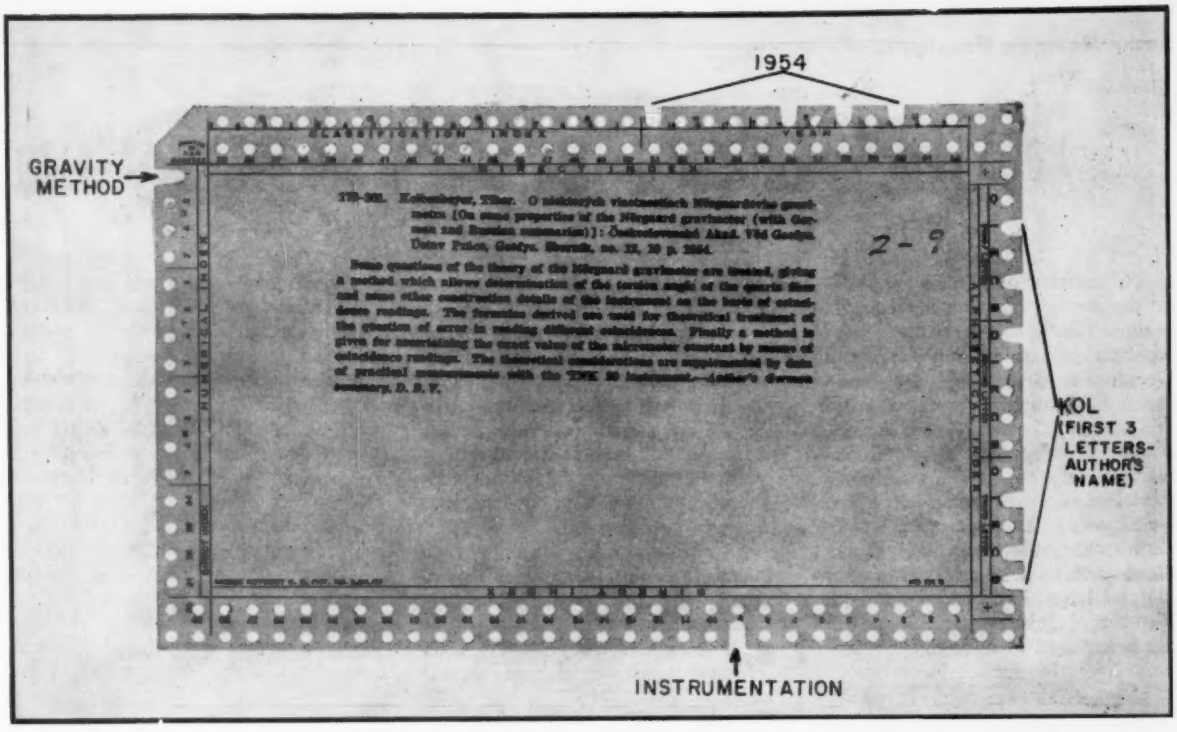
Screen Analysis

Product	Minus-150-Mesh	Minus-200-Mesh	Minus-270-Mesh
Tailing	89%	75%	60%
Concentrate	97	90	81
Middling	95	87	74

Ball consumption, 2.5 pounds per ton milled.

Electric power consumption, 21.0 kilowatt hours per ton.

Gallons water used, 1,000 per ton.



PUNCH CODED CARD set up by Bear Creek Mining Company is part of a complete bibliographic index of all geophysical literature. This card shows, (1) the method, (2) subject matter, (3) instrumentation, (4) date, and (5) first three letters of author's name. By threading a long metal rod through certain holes all the references on a certain subject, or on a certain author, can be removed from the file at once. Each card contains full details of publication and a summary of article.

GEOPHYSICS used in Rocky Mountains to trace uranium channels, locate narrow veins, and determine depth of desert sand and gravel

By Charles E. Melbye

The Rocky Mountain area, although highly productive in most mineral commodities, has seen only limited use of mining geophysics in exploration. It has lagged behind other areas, notable, eastern and southwestern United States and Canada.

Extreme terrain conditions make gravity and electromagnetic-surveys very costly and introduce added interpretation problems in all of the methods. Accessibility is difficult during the severe winter months. Probably the chief reason is that no spectacular discovery has been made to simulate the use of geophysics by the numerous small companies engaged in exploration.

Mr. Melbye, a consulting engineer, is head of Melbye and Associates with headquarters at 1117 Washington Avenue, Golden, Colorado.

There is no question that the Pima copper discovery in Arizona and the New Brunswick; Highland Valley, British Columbia; and other discoveries in Canada have been a "shot in the arm" for mining geophysics in those areas, There is every reason to believe that similar spectacular discoveries are forthcoming with similar effects in the Rocky Mountain area.

Mining geophysics during the past two years showed a continued modest expansion even among the small companies in spite of the depressed base-metal markets, uncertain or poor markets for other mineral commodities, and the curtailment of uranium exploration. The trends toward smaller geophysical equipment, such as transistorized units, and faster and more easily-operated equipment such as the new Varian and Sharpe magnetometers, are reducing costs and thereby enhancing the value to exploration departments, ever conscious of limited budgets. Furthermore, new developments such as in AFMAG magnetic-telluric current methods for greater depth penetration and induced polarization for disseminated sulphide deposits offer new applications of inherent tremendous value.

Airborne work has tapered off, but this type of work promises to increase in importance as better instrumentation and procedures are developed. Significant advances are the beginning of airborne gravity surveys by Lundberg Explorations, Ltd., electromagnetic systems for very light aircraft such as the Cessna, the dual airplane electromagnetic procedure as developed by A B E M Co. of Sweden.

This review covers the Rocky Mountain area states. Since more than one method is frequently used on a particular exploration project, no attempt will be made to divide the review by methods but rather by types of deposits plus research.

U. S. Geological Survey's laboratory and

A discussion of mining geophysics in the area would not be complete without mentioning the vast amount of research constantly being done by the Geophysics Division of the United States Geological Survey at the Federal Center, Denver, Colorado. L. C. Pakiser reports that integrated electromagnetic field and laboratory model studies are being carried on continuously. An entire album of experimental electromagnetic model curves will soon be released to open-file and later published as a bulletin. Theoretical electromagnetic curves are being used to solve thicknesses of non-conductive surface layers such as continental ice and dry desert gravels, a problem very important in the search for covered mineral deposits.

Electromagnetic, resistivity, and seismic refraction surveys completed a few years ago on the uranium-bearing channels of Monument Valley, Arizona and Utah are continuing to be analyzed. Many of the channels defined by the three methods have been proved by drilling.

Favorable results have been obtained with electromagnetics in iron-ore exploration, since the induced and permanent magnetic effects can be separated and thereby provide useful information not gained from magnetic surveys alone.

The physical properties laboratory at the Denver Federal Center is conducting fundamental research and measurements on rock properties. Conductivities, dielectric constants, and induced polarization effects are being measured, often utilizing drill hole logging techniques. In this manner the emphasis is placed on the properties of rock in place rather than lab measurements. Oil well logging devices are being adapted to smaller mining drill holes; induced polarization and magnetic susceptibility loggers have been developed. Physical properties of the Morrison and Shina-

Use electrical methods for uranium . . .

Radiometric methods are not being covered since they are used as a necessary routine tool in all uranium exploration. However, the increased use of electrical methods in uranium exploration is noted. Especially has this been true in the search for the primary uranium deposits of central Colorado and the Front Range. Two surveys have been completed by Frank Seward, consulting geophysist, the first a self-potential survey of 300 Acres for La Sal Mining Company in the Jamestown district, Boulder Colorado. Limited success was attained in that pyritic zones, often accompanying pitchblende, were found, but as yet drilling has not disclosed economic uranium mineralization. Additional drilling on these anomalies is in progress. A limited amount of self-potential work was completed for Continental Materials Company, on its property near the Schwartzwalder mine north of Golden, Colorado. One 200 to 300 millivolt anomaly was found in the favorable garnet-biotite schist, but it must yet be drilled. Also, test profiles were run over the Schwartzwalder mine of Denver-Golden Oil and Uranium Company. One vein showed a substantial anomaly of 300 millivolts and a second was inconclusive.

DIAMOND DRILLING (see center right) an electromagnetic anomaly for the Knight Mining Company, Breckenridge district, Colorado.

Resistivity and self-potential surveys have been completed in the Marshall Pass district of Saguache County, Colorado for Gibralter Minerals Company.

Self potential work over a known ore body in the Belden formation at a 200 to 300 foot depth showed negative results, but the resistivity method reacted very favorably. Extension of work into unknown areas gave two anomalies both of which were drilled and were found to be caused by highly carbonaceous and pyritized Belden shale. Both methods were unsuccessful in pre-Cambrian gneiss areas because of widely varying lithologic resistivity contrast.

An interesting application of the gravity method to uranium exploration was reported by Bill Starke, manager, O. A. Sutton interests. A gravity

field research headquarters in Denver

rump uranium channels of the Colorado Plateau are also being investigated.

Of particular interest in the ever-increasing search for mineral deposits covered by gravels and post-mineral volcanics are two projects: 1. Seismic investigations have been made with good results on a rhyolite flow near Castle Rock, Colorado to determine the thickness of this high-velocity layer overlying a low velocity layer (sediments). 2. Gravity methods have been used to determine the horizontal extent of the shallow portions of pediment gravels, thereby defining the portion of a pediment area which would be economic to explore.

Although the previous emphasis on gamma-ray logging is considerably reduced, an interesting side application is being made—that of determining rock densities and in-place moisture. A regional gravity survey of the Black Hills, South Dakota is being conducted. Extensive aeromagnetic and gravity surveys of the Colorado Plateau have now been published.

Considerable geophysical work of a regional or research nature with a possible mining application, has been completed at the University of Utah under the direction of Kenneth L. Cook, head, Department of Geophysics. A regional gravity survey is completed of a large area in northern Utah. Synthetic cores have been prepared and investigated as to seismic velocities and electrical properties. Seismic results of quarry blasts at Lakeside and Promontory Points, Utah, were studied.

In conclusion, geophysics has a bright future in the Rocky Mountain area if the proper applications and interpretations are used under the unavoidable difficult operating conditions. It is hoped that more of the smaller companies will be encouraged to use mining geophysics, for in their usage lies the possibility of many new discoveries.

magnetics for iron and fluorspar

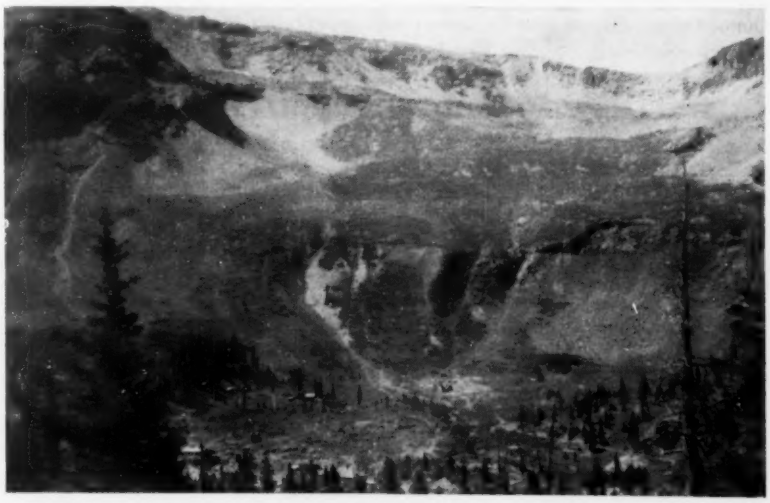
survey was successfully used to delineate solution cavities in the Madison limestone, loci for uranium deposits in the Pryor Mountain district, Wyoming and Montana.

Colorado Fuel and Iron Corporation, reports David Carter, chief geologist, recently has been engaged only in routine magnetic surveys in a number of the Rocky Mountain states. Specific information on scope, location, or results cannot be released.

Columbia Geneva Steel Division and Columbia Iron Company, both divisions of United States Steel Corporation, completed geophysical work in all the Rocky Mountain states of Montana, Wyoming, Colorado, Utah, and New Mexico. Clifford Mark, assistant manager Raw Materials Division, reports that standard magnetic, gravity, and geochemical techniques were used, both of a reconnaissance and a detailed nature. Research work is in progress on geochemical techniques and on remanent magnetism. Utah Construction and Mining Company is continually using magnetics for iron exploration in a number of the Rocky Mountain states, and recent emphasis has been on aeromagnetics.

The O. A. Sutton interests utilized the magnetic method in exploration for fluorspar deposits of the Powerhorn district, Colorado. Chief emphasis was to trace altered brecciated zones in granites which contain the fluorspar.

Ralph C. Holmer, chief geophysicist and George Rogers, senior geophysicist, Bear Creek Mining Company, report that only limited induced polarization surveys, utilizing equipment of their own design, have recently been completed in Colorado and New Mexico as well as limited geophysical work in Montana. From the research standpoint at the main Denver office, electromagnetic model experiments comprise the chief project. Of noteworthy interest is the continuing compilation of a complete bibliographic punched card index on all geophysical literature. An example of the cards is shown.



STEEP DIPPING quartz veins cutting rhyolite and andesite flows were traced by magnetic methods using terrain corrections.

Magnetic lows found over steep dipping veins

According to P. A. Meyer, geologist, "The Exploration Division of American Metal Climax, Inc., integrates the use of the exploration tools of geology, geophysics, and geochemistry whenever they are applicable to an exploration project. Experimental surveys, ground magnetics, airborne magnetics, gravity and geochemical testing of soils and bedrocks—have been made over the Climax Molybdenite Ore Body. At most exploration projects various geophysical techniques and geochemistry have been used to supplement the evaluation of the geologic setting."

An interesting and thorough Master of Science thesis problem, entitled, "A Geophysical Investigation in Richmond Basin and Upper Camp Bird Valley, of the San Juan Mountains, Ouray, Colorado," was published in 1958 at the Colorado School of Mines by John D. Corbett. Magnetic, resistivity, electromagnetic, and self-potential methods were employed in an investigation of narrow steeply-dipping base and precious-metal veins. Extremely steep terrain offered the opportunity to apply magnetic terrain corrections as proposed by Paul Rodgers and John C. Hollister, professors at the Colorado School of Mines. Magnetics, after the application of terrain corrections, showed lows of 200 to 500 gammas over the veins. These corrections illustrated their value by eliminating some anomalies due only to terrain and smoothing out others. Resistivity methods although showing low anomalies of about 2,000 ohm-feet over the veins, also indicated similar anomalies in water-saturated zones, thereby making interpretation difficult. Electromagnetic and self-potential methods were not successful. The San Juan Mountain region of Colorado has seen little geophysical exploration possibly due to extreme terrain conditions. Corbett's work illustrates the value at least of magnetics and possibly of resistivity methods for this important mineralized region.

STEEP SLOPES and high relief typical of San Juan Mountains above Camp Bird mine, Ouray, Colorado where John D. Corbett made experimental surveys.

A possibly significant geophysical discovery is in the making by Gold Eagle Mining Corporation and Anschutz Drilling Company at their exploration project on Mt. Shavano northwest of Poncha Springs, Colorado. High-grade fault-drag boulders of copper-lead-zinc sulphides were discovered in a 160-foot shaft sunk by the company near an old shaft reported to contain high-grade gold. Due to a surprising 50 to 300 foot thick cover of glacial till, resistivity and electromagnetic surveys were run along the major fault zone, disclosing two coincidental substantial anomalies near the shaft. About 1,000 feet of tunnel has been driven through and along the fault which is being followed by underground and surface drilling to the calculated depths of the anomalies. Recent work has consisted of magnetic surveys to give some inkling of bedrock composition. Little is actually known of the geology because of the glacial till and further work should soon determine the significance of the electrical anomalies.

Costs—Lower than you think—Only $18.00 to $54.00 per acre

Cost of running detailed electrical surveys over a 55 acre area with thick aspen and pine timber was $54.00 per acre. Cost of magnetic surveys over the same general area averaged $18.00 per acre. These reasonable costs were achieved under the conditions of an operating mine where helpers from the mine working force were available when needed.

Knight Mining Company utilized electromagnetic and self-potential surveys in conjunction with a base metal drilling program in the Breckenridge district, Colorado. Although an economic ore body was not found, the only significant mineralized zone (60 feet of pyrite with minor lead-zinc-silver) was disclosed with the horizontal loop-electromagnetic method. Because of rugged terrain, station elevations to the nearest half feet were surveyed and terrain corrections successfully applied. A coincidental self-potential and electromagnetic anomaly over the suspected location of a faulted undiscovered ore body is yet to be drilled.

Cost of the electromagnetic survey over a 28 acre tract on 100-foot spacing was $38.00 per acre. Timber cover is thick but the area is very accessible. The self-potential survey in addition was experimental and covered only a limited area.

For limited areas and detailed problems, an expenditure of $1,000 to $5,000 on geophysical surveys could be of substantial benefit and still be within the budget of a small company. The new mining laws relating to assessment work permit geological and geophysical work, and it is hoped that many small companies will take advantage of this law rather than deepen the same cuts or extend the same workings year after year and accomplish little new exploration. END

MONEY-MAKING METHODS

Automatic Tail Gate Cuts Anaconda Trucks Spill at Yerington

Anaconda Company's mining staff at the Weed Heights, Nevada open pit copper mine has developed a simple automatic tail gate to eliminate spillage from dump trucks.

When the Diesel trucks climbed out of the pit under full load, up the 8.0 percent grade, rocks rolled off the load and fell onto the road. These rocks often cut the tires of the following trucks.

By installing the simple automatic tail gate shown in the photographs above, this spillage is prevented and now there also is a little extra "bonus" load for each truck. However, this additional load is incidental as the main purpose is to avoid spillage.

The tail gate is built of half-inch steel plate 6 inches high and is 11 feet 3 inches in length. The bodies of the haulage trucks are 10 feet 6 inches wide inside; the difference between the overall length of the tail gate, 11 feet 3 inches, and the inside width of the body, 10 feet 6 inches, allows sufficient room on each side of the truck in order to place counter balances at each end.

There are three hinge pins for the tail gate, each 2 inches in diameter and 24 inches long. The counter balances are made from 6-inch-diameter shafting.

When the truck is raised to dumping position as shown in right picture, the tail gate automatically opens and raises the counter weights allowing the material to flow out easily without damaging the gate. As the truck body is lowered, the counter balance drops to close the tail gate.

This is another of a series of cost-cutting devices made available to the mining industry by A. E. Millar, general manager at Weed Heights.

How To Charge Mine Storage Batteries

The most common abuse in the operation of mine storage batteries is overcharging. Continual overcharging can shorten battery life by more than 50 percent.

Modern automatic charging equipment, properly adjusted, offers little excuse for charging over the fully charged limits. Nevertheless, it is possible for this apparatus to get out of adjustment, and periodic checks should be made to insure continued satisfactory operation.

There are two general methods of charging batteries: 1. the modified constant voltage method, and 2. the two-rate method.

The modified constant voltage method employs a charging source capable of maintaining a constant voltage within reasonable limits regardless of the load on the equipment. This method takes advantage of the rising voltage characteristic of a charging storage battery to reduce the charging rate systematically as the battery approaches full charge.

The two-rate method of charge is controlled almost entirely with ballast resistance of sufficient rating to handle the required charge rates. This method is employed where design factors of charging equipment are outside the limits of modified constant voltage specifications. Additional resistance can be cut into the circuit at the gas voltage (2.37 volts per cell), either manually or automatically, without interrupting the charge.

Equalizing charges should only be given to overcome any inequality in voltage or specific gravity which has resulted due to continuous cycling over a long period of time. Equalizing charges are not a cure-all for all battery ills, and normally these charges should only be required about once or twice a month. The equalizing charge, it goes without saying, will not cure a broken jar, a broken separator, or loss of electrolyte through overflushing, upset, or other causes.

The boost charge is not a regular method of charging storage batteries and should not be confused as such. It is essentially a supplementary charge which is usually given to prevent overdischarging.

The boost charge is generally a high-rate charge of short duration given during a rest period to insure completion of the particular shift the battery happens to be working on. When it is found that boost charges are required, investigation will almost always disclose that (1) battery capacity is insufficient to meet the duty required, (2) the duty cycle has been greatly increased, (3) charging equipment has not been functioning properly, or (4) the battery is getting old and is approaching the end of its useful life.

COLORADO CONVENTION

RAISE DRIVING in Colorado has been speeded by use of Alimak Raise Climber says J. Borgenhard of Sweden.

EUROPEAN METALLURGICAL developments were outlined by Professor Frank Forward, University of British Columbia.

Beryllium, columbium, yttrium, molybdenum, and tungsten—the space age metals of tomorrow—drew the crowds and attracted prospectors to presidents to the National Western Mining and Energy Conference. This annual conference sponsored by the Colorado Mining Association is traditionally held early in February in Denver. It has grown so large, however, that it was postponed until the new Denver Hilton Hotel was opened so that record convention exhibits, technical sessions, and banquets could be held simultaneously under one roof.

It could well be that the most important event of the Convention was the Minerals Policy Speech of Senator Lyndon B. Johnson of Texas, Senate Majority Leader, at the Gold and Silver Banquet. Senator Johnson in this speech to the nation's mining industry called for a "sane, progressive National Minerals Policy. There should be a joint Executive-Legislative-Industry Commission on Minerals to do the job." This Committee should "study the problem from the standpoint of the national interest—from the standpoint of determining how we can meet our needs today and the needs of future generations . . . let us lay out our long term goals, and the long term policies and programs which the industry and government must pursue if we are to achieve these goals."

In concluding his speech Senator Johnson said, "For in the future, as in the past, the vigor of this country's economy will depend upon the development of our mineral and energy resources—and the wisdom with which we use those resources."

While there were numerous sessions on uranium and a special panel on lead-zinc headed by Ed Snyder, president, Combined Metals Reduction Company, Salt Lake City, Utah, it was the space age metals that rocketed away with the mining industry. Beryllium in particular was of interest, and there were several very interesting displays, one featuring, for the first time, a new very light weight completely portable berylometer. The United States Geological Survey announced for the first time that it was developing instruments for continuous drill core scanning for beryllium minerals, and for small diameter drill hole logging (1¾ to 2¾ inches). These instruments are scintillation counters with a boron-enriched, zinc sulphide-polyester neutron detector that emits a flash of light when struck by a neutron originating from beryllium. The detection is highly selective and will respond only to beryllium. And will, of course, positively identify the rarer minerals which are totally impossible to identify by eye. These new instruments will grow in use and without doubt will be as important to the beryllium prospector as the Gieger counter has been to the uranium miner.

Under optimum conditions these instruments will provide an almost instantaneous indication of the amount of beryllium present at a nominal cost. W. W. Vaughn of the United States Geological Survey, Denver, will answer prospector's questions about these instruments.

Why Interest in Beryllium?

There is a $6,000,000 annual market for beryllium ores and concentrates in the United States reported David H. Hershberger, treasurer, Brush Beryllium Company, Cleveland, Ohio. He predicted imminent development of "an important beryllium ore mining industry in North America." Such an industry is vitally needed to counteract our dependence upon foreign sources of hand cobbed beryl ore.

The beryllium industry has recorded a remarkable growth in the last 10 years as the following figures show: In 1950 sales were $9,485,992, plant investment was $3,392,843, and beryl consumption was 3,007 short tons. By 1959 the industry had grown to sales of $39,312,774, plant investment of $20,739,085, and consumption of 8,127 short tons of beryl.

Impressive as these figures are, the rapidly growing needs and uses of beryllium point to an even greater demand in the future. It is truly an atomic and space age metal as it finds use as a moderator and reflector in

features space age metals

ELECTRIC TRUCK haulage at Anaconda's Berkeley pit doubles speed and grade for 75 ton loads, reports Ed Borcherdt.

URANIUM and toastmastering kept Jess Larson busy at convention. He is traditional banquet master of ceremonies.

STANDARD URANIUM'S activities in the San Juan Mountains of Colorado are outlined in detail by Russell Wood.

atomic energy applications and the builders of guided missiles and aircraft are evaluating beryllium for a wide variety of applications, reported Mr. Hershberger.

Now that the miner has an assured market for his beryllium ores and a new instrument to help him locate and assay where should he look for deposits? This question was answered by Dr. Norman C. Williams, professor of geology, University of Utah, and vice president, Beryllium Resources Inc. Dr. Williams has spent more than 20 years examining beryllium deposits in all parts of the world and is now directing a vast scientific search for other deposits. As an adjunct to this search Beryllium Resources has developed a most promising flotation reagent for economical recovery of finely disseminated minerals. Dr. Williams outlined how the real search began 25 years ago and reviewed the following five key events in that period.

1. Pegmatites, the largest source to date, have been extensively sought and mined. While pegmatites can and will produce for a long time they have the following disadvantages to make beryllium a really large tonnage metal: they are limited in size, more than 1,000 tons have been mined from very few, and all ore must be hand cobbed.

2. Non-pegmatitic source was discovered at Iron Mountain, New Mexico when helvite was found in a tactite zone. Metallurgy has not been solved to date, however. This led to search in contact metamorphic zones.

3. In 1942 beryl was found in clusters in granite at Sheep Rock Mountains, Utah. This led to search in intrusive granites. Beryl has been found in some too.

4. Discovery of beryllium minerals in greisinized areas at the Boomer mine in Park County, Colorado has increased the areas to be prospected.

5. The Mt. Wheeler, Nevada discovery in a contact metamorphic zone with tungsten and fluorspar adjacent to fissures opened still another type of occurrence for further geological search.

In conclusion he advised prospectors to, "Look in acidic intrusions; in high, medium, and low temperature deposits; in greisenized areas, and fluorine rich zones. There are many others too," he added.

Columbium in Colorado

The DuPont Company is developing an important carbonatite columbium deposit at Powderhorn, Colorado, reported Dr. Robert M. Grogan, company geologist, of Wilmington, Delaware. More than 100,000 tons of 0.25 percent Cb have been indicated with substantial tonnages of higher grade. The deposit has an encouraging economic outlook and the company will drive an adit this summer, mine a 100-ton bulk sample for metallurgical testing, and have the deposit ready for production for future needs. Dr. Grogan compared the Powderhorn deposit to those of Africa where a carbonatite complex (apatite, vermiculite, columbite), and rare earths were formed in a volcanic throat ringed with altered rocks. A note to prospectors; Dr. Grogan emphasized the mineral assembly and a characteristic contoured and banded outcrop standing prominently above the surrounding rock.

Hydrometallurgy Brightest

Professor Frank Forward, University of British Columbia, Vancouver, Canada said that the field of application for hydrometallurgy in mineral processing is "wide open with many opportunities for improving processes. Fluids are easy to handle, that close control is very easy to achieve, and that imagination and courage will solve many mineral recovery problems." He foresaw the expansion of solvent extraction for many other metals (uranium and vanadium have been most important to date) and added that the Russians were already doing a lot with organic materials as metal extractants.

Import Tax Bill Supported

Clark L. Wilson, chairman of the Emergency Lead-Zinc Committee was the main speaker at the lead-zinc sec-

In recognition of the outstanding achievements and technical developments made by mining companies and mining and metallurgical engineers, MINING WORLD makes five annual awards. These awards best express the industry's appreciation for the work that is done for the advancement of all mineral sciences, and for the enlightened management and operation of today's mining enterprises.

UNDERGROUND MINE OF 1959 honor goes to Colorado's Idarado Mining Company. Manager John Wise (right) accepts silver and marble plaque from Mining World Editor George O. Argall, Jr.

TECHNICAL ACHIEVEMENT award was presented to Prof. F. A. Forward, University of British Columbia, for his metallurgical developments in high and low temperature and pressure leaching.

OPEN PIT MINE OF 1959 was judged as being operated by Pima Mining Company of Tuscon, Arizona. Mine superintendent Robert Thurmond is congratulated for the honor his company received.

MAN OF AMERICAN MINING IN 1959 was Johnson Crawford, assistant manager of mines, New Jersey Zinc Company. The award is a tribute for finding and mining Tennessee zinc ores.

SMALL MINING COMPANY OF 1959 was a uranium firm, the Four Corners Exploration Company, of Grants, New Mexico. President Irving Rapaport keeps plaque on his desk in front of him.

URANIUM EXPERTS, from discovery to marketing, were members of a special panel. From left they are with their subjects: Don Delicate, mining methods; Tom Vogenthaler, investment possibilities; Pat Selak, marketing forecasts; Bob Beverly, radiation; L. Hazen, metallurgical advancements; and Jack Robison, exploration.

tion and reported that the domestic miners were in accord with the premise that a "Healthy domestic industry can be achieved through import taxes, quotas, or a combination. We have consistently preferred import taxes as the method of curtailing excessive imports. The Emergency Lead-Zinc Committee intends to continue this policy and will work for the passage of H. R. 11786, the Import Tax Bill, recently introduced in this session of Congress. This is the 4.0 cents-on and off-peril point plan. Taxes are suspended above the peril point, a combined 29 cents. However, taxes on either metal stay on until the 29 cent combined price is reached."

Electric Truck Haulage

The long awaited revolution in open pit truck haulage is a reality today at the Anaconda Company's Butte, Montana, Berkeley pit reported Edward R. Borcherdt, consulting engineer of San Francisco, California. A 1,600-horsepower electric wheel driven truck powered from an overhead trolly is hauling 75 ton loads out of the pit up a special 15 percent grade at 12 miles per hour.

Mr. Borcherdt asked the group to think for a minute what this can mean to the mining industry. "Higher stripping ratios, deeper pits, smaller waste dump areas, and lower costs per pound of metal. Remember that today the most favorable Diesel truck operation is from 22 to 50 ton loads, on 7 to 8 percent grades, at speeds of 4 to 5 miles per hour. Thus by one broad step this new truck doubles both speed and grade and it is expected that capacity will eventually be doubled with no increase in manpower."

Future For Drilled Shafts

The mining industry has drilled, or is now drilling, 68 holes larger than 20 inches in diameter for use as shafts, was the report at the special mining section. William I. Wohlfeld, Hugh B. Williams Company, Dallas, Texas, spoke on "Large Diameter Rotary Drilling of Vertical Shafts"; and S. C. Berube, Hughes Tool Company, Houston, Texas described the "Operations of Self-Propelled Down-Hole Shaft Boring Machines." Highlights of these papers include: after a long close study of results from these 68 shafts the future looks good for regular six to eight foot diameter shafts. "The price can be made right so the drilling industry looks to the miners for the future."

The United States Atomic Energy Commission's project Mercury in Nevada has served as a proving ground for hard drilling. A 990-foot deep hole was first drilled at 12¼ inches and then reamed to 44 inches through granite in 65 days, or an average of 0.6 feet per hour. It required 2,500 pounds of pressure per inch of bit diameter to drill this granite. Much of this special equipment is now being used to drill ventilation and escape shafts in the Ambrosia Lake, New Mexico uranium district.

EXHIBIT HALL was crowded during the convention as engineers stopped to check latest machinery on way to meetings.

MINING MEN MEET at Denver and start talking. These two groups are discussing columbium and vanadium.

CANADIAN delegate, Professor Frank Forward (center) University of British Columbia, talks with A. W. Fletcher, England (left) and A. A. Maslenitsky, Russian Institute of Mining.

Mining World-World Mining photographs.

UNITED STATES professors, J. N. Butler, University of Nevada (left), and A. M. Gaudin, MIT, talk over a technical point with R. Testut, Société de L'Industrie Minerale, Paris.

Russian Delegates Dominate Flotation

By Bernard W. Lansdowne A. M. I. Mech. E.

That Russia is now the world center of flotation research was the shocking but unchallengeable statement made at the fifth International Mineral Processing Congress which was held in London, England in April. This marked the return of this world-important function to the country responsible for organizing the original session in 1952. The meeting was supported by no less than 676 delegates from 40 countries.

The international aspect of the symposium is very well presented by MINING WORLD's camera which successively pictured delegates from Canada, England, Russia, the United States, France, West Germany, Spain, Ghana, Union of South Africa, the Netherlands, and Sweden.

As will be expected the United Kingdom as host nation provided the largest contingent, totalling 230, with France and Western Germany next in order, having 66 and 64 respectively. The United States delegation of 10 was made up of R. E. Barthelemy, Hanna Mining Company, Jacksonville, Florida; J. B. Bond, Nordberg Manufacturing Company, Milwaukee, Wisconsin; R. B. Brackin, Kennecott Copper Corporation, New York, New York; J. N. Butler, University of Nevada, Reno, Nevada; F. D. DeVaney, Pickands Mather & Company, Duluth, Minnesota; M. C. Fuerstenau, and A. M. Gaudin, Massachusetts Institute of Technology, Cambridge, Massachusetts; R. J. Morton, United States Steel Company, Duluth, Minnesota; J. E. Schork, Research-Cottrell, Inc., Bedminister, New Jersey; and R. H. Spedden, Union Carbide Ore Company, New York, New York.

Messrs. Gaudin and Fuerstenau presented a paper on the "Mechanism of Thickening"; Fred DeVaney spoke on "New Developments in the Magnetic Concentration of Iron Ores." "Electrical High Tension Minerals Beneficiation: Principles and Techniques" was coauthored by R. E. Barthelemy.

The Russian contingent of 44 included a number of women delegates. These latter, I was reminded by Boris Belitzky the Russian interpreter from Radio Moscow in accent-free word-perfect English, were scientists in their own right. The Russians certainly take their technology seriously. Other Iron Curtain countries also sent their representatives and perhaps the most travelled delegates were the three from Japan and the group of 10 from Australia.

Coincident with the technical session and in two small halls adjacent to the main assembly hall was staged a Mineral Processing Exhibition under the sponsorship of the British Chemical Manufacturers Association.

Next Symposium in France

Commenting as it were on last things first, readers will be interested to know that at the conclusion of the technical sessions during the various farewell speeches and votes of thanks to the organizers, it was announced that an offer by Mr. P. Seyer on behalf of the French delegation had been accepted whereby the next Congress would be staged by France in the Mediterranean city of Cannes; this was timed for 1963. At the same time Mr. Rush Spedden of the Union Carbide Ore Company, on behalf of the American Institute of Mining, Metallurgical, and Petroleum Engineers, announced that an international meeting will be staged in New York in 1964 coincident with the World Fair and with the added importance of its being the centenary of the foundation of the School of Mines at Pontiac University. It was also announced that Professor Plaksin of the Academy of Sciences, USSR, had extended an invitation to organize one of the subsequent international meetings on Russian territory.

The opening day of the official program was taken up partly with registration formalities and with an official reception for members and their

WEST GERMAN delegate Dipl. Ing. O. Burghardt of Goslar (left) and his wife in conversation with M. A. Garcia Corral of the Spanish Atomic Energy Junta de Energia Nuclear, Madrid.

Mining World-World Mining photographs.

GHANA delegates at the meeting were J. Mitchell, Geological Survey (center), and H. Benyah, Mines Department (right), with D. L. Watson of England's Warm Springs Laboratory.

Section at Ore Dressing Symposium

Manager, United Kingdom, MINING WORLD and WORLD MINING

ladies. But as an hors d'oeuvre to the main working sessions the first day's program also included the presentation of the fifth Sir. Julius Wernher Memorial Lecture. This was delivered by Dr. I. W. Wark, Director of the C.S.I.R.O. Chemical Research Laboratories in Australia, who chose as his subject the "Exploitation of Minerals for Mankind."

Metallurgists Make New Mines

The opening proper was performed by Britain's Minister of Science, Viscount Hailsham, but unfortunately it seemed that many delegates had become engulfed in London's traffic, disrupted on that day by the state visit of France's General de Gaulle and many, therefore, were unable to be present during his speech.

Viscount Hailsham in his opening remarks commented on the international character of the gathering with 40 countries represented and with papers from 18 different nationalities. The history of civilization, he continued, has marched closely in step with mineral development so today, almost every item of the enormous wealth of luxury we enjoy is made from, or has been made by machinery made with, some kind of metal. The rising standard of living throughout the world, however, is increasing the demand for the world's supply of metal-bearing ores to a point where many of the most accessible sources at present known to us are gradually being used up. Most serious of all, he felt, is that the high grade ores are being expended at the quickest rate and some are almost exhausted. As raw materials are used up, however, the search for unknown ores goes on in more remote regions and deeper into the earth's crust, or even out to sea. Rich mines are becoming fewer and harder to find, especially near the surface, and attention must inevitably be directed more and more towards the resources which a few decades earlier would have been considered untreatable or quite uneconomic.

Viscount Hailsham felt that these trends have been strikingly illustrated in the case of gold and, more recently, in uranium. In both instances major advances in processing have made possible the tapping of vast new resources as well as a reduction in the cost of production. He cited the introduction of cyanidation for gold ores and of ion-exchange for those of uranium, which have had far-reaching effects on the economic development of countries like South Africa and Canada. In Great Britain moreover, improved ore dressing techniques may one day promote the economic working of those known ore deposits and parts of deposits which are still uneconomic, for example in the leaner parts of Cornish tin-lodes.

Mineral processing, he concluded, impinges on many fields of science and technology; those of the mineralogist, the mining engineer, the chemical engineer, the chemist, and the physicist. It has too often been regarded only as an adjunct of mining geology or metallurgy and, in recalling that so far as the United Kingdom was concerned, there were at present facilities for courses in mineral processing at the Imperial College of Science and Technology, Camborne School of Mines, or as part of mining courses at other provincial universities, he felt strongly that the time has come to consider whether some considerable extension to these facilities for studying mineral processing should be put in hand.

The technical sessions proper were split up into sections comprising comminution, classification and thickening, flotation research and practice, separation, chemical processing, process study, and control and testing. There was in addition a final session on the closing morning devoted to a review of the proceedings and partial replies by authors to some of the points raised in the discussions.

RUSSIAN delegate leader Professor I. Plaksin, Academy of Sciences USSR (right), his wife, and Professor S. I. Polkin, Kalinin Institute of Nonferrous Metals, USSR (left), talk with Dr. M. G. Fleming, London's Royal School of Mines.

Mining World-World Mining photographs.

ENGLAND'S F. B. Michell, vice principal, Camborne School of Mines, Redruth, Cornwall (left) and his wife pose for MINING WORLD's camera with Mr. and Mrs. F. D. L. Noakes of the Consolidated Gold Fields of South Africa Ltd.

Many delegates, as at past similar conferences, considered that the program was somewhat too heavily weighted on the academic and scientific side, with perhaps too little emphasis on the practical applications of existing techniques.

Russian Papers Bring Discussion

Ironically it was perhaps the most academic groups on flotation research and flotation practice which stimulated the most intense discussion. No less than five of the eight papers in this section were from Russian authors including three of their remarkable women delegates. Dr. Fleming of the Royal School of Mines in London, who was charged with the responsibility of introducing what he called this large and formidable group of papers, remarked that it was no accident that five of these papers originated in the USSR, for the scientific lead in flotation research is now unquestionably with the Russians. He felt that it was interesting to note how the center of theoretical study has travelled since the process originated. The pioneering work was done in England by Sulman and Picard, and in Australia, where the first large-scale application took place between 1904 and 1912. By 1928 the lead had passed to Columbia University in New York under Professor Taggart and by 1935, thanks to the efforts of a small group of physical chemists under Dr. Wark, Australia was once more established as the chief center of study. However, by the end of World War II leadership was back in the United States, this time at Massachusetts Institute of Technology under Professor Gaudin, who was in fact chairman of the flotation session. With the resumption of exchanges of scientific information between Eastern and Western Europe it gradually became apparent that the center of gravity had shifted once more—this time to Moscow. Dr. Fleming felt that Dr. Wark in his Memorial Lecture had probably put his finger on the explanation for this frequent change of leadership when he spoke of the law of diminishing returns in flotation research. Such a high degree of mobility, he felt, will give our Russian colleagues fair warning that they must look to their laurels for subsequent meetings.

Dr. Fleming introduced Russian Professors Bogdanov, A. K. Podnek, V. J. Hainman, and N. S. Mikhailova of the Institute Mekhanobr, Leningrad and made the following remarks on their paper on "Kinetics of Flotation Reagent Sorption."

"This paper is concerned with the liquid-solid interface; this time in the elucidation of some extremely important phenomena involved in the xanthate flotation of lead, copper, and zinc sulphides. Using what appears to be an extremely efficient adsorption column technique, the authors have provided a substantial addition to the limited data on the kinetics of reagent adsorption. The experimental results include the rate of adsorption of both ethyl and butyl xanthates on galena, copper on sphalerite, and the rate of removal of copper by cyanide from activated sphalerite, chalcocite, bornite, and chalcopyrite. The ingenious double adsorption column technique and correlation with actual flotation tests have vividly illustrated the mechanism of cyanide depression and explained the difficulty of separating sphalerite from ores containing secondary copper sulphides. Another classical flotation theory is exploded with the authors' experimental proof that cyanide ion adsorption is practically of no importance in the depression of minerals with cyanide."

"Physical Stability of Collector Adsorption Layers on Mineral Surfaces and Methods for their Destruction" was presented by Prof. Glembotski. Dr. Fleming said that, "Professor Glembotski's paper on basic research is of great practical interest and usefulness. Despite such established examples as that of Climax Molybdenum Company there are all too few cases in which flotation operators have fully exploited the advantages of a preliminary bulk flotation of the valuable minerals. The reason, of course, is that in flotation, as in many other fields of human activity, it is easier to prevent something from happening than to correct it after the event and, once a mineral has been collector coated to a degree that will permit its efficient recovery in a bulk concentrate, it is extremely difficult to depress it in a subsequent separation stage."

The paper by Prof. M. A. Eigeles and Miss M. L. Volova of the Mineral Institute of the Ministry of Geology, Moscow, dealt with "Kinetic Investigation of the Effect of Contact Time,

DUTCH State Mines was represented by J. H. Bitter (left) who attended with English mining professors Dr. A. Jowett, Leeds University; Dr. R. L. Whitmore, University of Nottingham; and Dr. C. C. Harris and C. C. Dell, Leeds University.

Mining World-World Mining photographs.

SWEDISH metallurgists present included M. Vallfors (left) and S. Sjoberg of the Alunda and Faun mines respectively of Stora Kopparbergs Bergslags. They are pictured with another Swedish delegate, B. Holmstrand, Dannemora Gruvor.

Temperature and Surface Condition on the Adhesion of Bubbles to Mineral Surfaces." Dr. Fleming said, "For nearly 25 years the term 'inherent floatability' was one which could not be used in western mineral dressing circles except in relation to a few special cases. Throughout most of this time the heretical voice of Prof. Eigeles could have been heard crying in the wilderness had one but listened. Now, with patience and tolerance, he describes the most recent results of a research program which dates back to 1937 when he first published experimental data on the induction time for the adhesion of untreated mineral particles to air bubbles. This induction time characterizes the total period of thinning out of the boundary aqueous layers to the point at which attraction forces balance repulsive forces. The induction time depends on mineral particle mass, bubble size, the degree of mineral surface hydration and, consequently, on the concentration and adsorption of all reagents, temperature, etc."

"Some Factors Affecting Selectivity in the Differential Flotation of Lead-Zinc Ores Particularly in the Presence of Oxidated Lead Minerals" by Prof. Rey and V. Formanek of the Ecole Nationale Superieure des Mines, Paris poses as many problems as it solves. Arising from difficulties encountered in the flotation of a number of natural ores, the investigation covers the influence of the type of gangue, iron from the grinding mill, soluble salts, and the effects of associated minerals on the differential flotation of lead and zinc ores.

Gaudin Describes Transviewer

Another group of papers under the heading Classification and Thickening, also stimulated keen discussion and it was this group that included among its five papers one of the American contributions under the joint authorship of Professor Gaudin and M. C. Fuerstenau. Their paper was entitled "On the Mechanism of Thickening" in which they use the transviewer, an instrument first described in 1958. It shows the concentration of solids in suspension at any given time in a settling pulp, without disturbing the system, by means of an X-ray technique. After presenting the data, the authors apply the X-ray and transviewing qualities of mathematics to what Dr. Pryor of the Imperial College of Science in London, who introduced the papers in this section, described as "the turgid mysteries which lurk below the mud line in thickening."

Dr. Pryor in his summary pointed out that ore treatment of the kind called for with large tonnages of low-grade and often complex minerals demands orderly and efficient preparation at each stage if the concentrating processes are to work smoothly. When comminution has played its part, classification must ensure that smooth delivery is made of a product liberated to an optimum size range, at the required solid-liquid ratio, and rate of feed. These elements of the correctly produced pulp-mash-of-grind, specific surface, dwelling time, and rate of delivery can only be attained and maintained when the forces at work are understood, mutually adjusted, and properly controlled. Failure leads to "rough running"—irregular sedimentation, incipient choking, and mild surging. The consequences are then reflected in poorer results from the concentrating processes which are being forced to work on a jumpy feed.

As regards consistency of a pulp, the size analysis of its solid fraction, together with the solid-liquid ratio, bears directly on the reactions which can be controlled during concentration, whether the forces used are gravitational, electrical, chemical, or surface-active. This session, Dr. Pryor felt, covered concepts of far-reaching importance to the subsequent behaviour of material released from this stage of preparation to the later ones of conditioning and treatment.

Throughout the entire proceedings a consistently high attendance was maintained at the technical sessions and the instantaneous four-language translation of the proceedings generally seemed to work satisfactorily. A bound volume of the proceedings of the Congress containing all 52 papers and a report of the discussion will be available in August this year from the Institution of Mining and Metallurgy in London at a price of £5 ($14.00) per copy.

In the week subsequent to the technical meetings there was a full program of tours throughout British centers of industrial interest including visits to mining operations, steel works, colleges and the works of numerous manufacturers of mining equipment. END

PRODUCTION EQUIPMENT PREVIEW

For data on any item on next three pages use the inquiry card opposite page 52

Automated Heavy Media Process Holds Density Medium to Within .0003

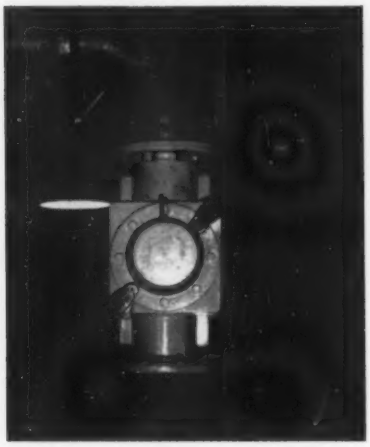


Fig. 1

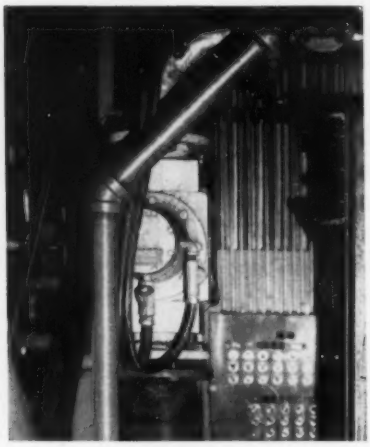


Fig. 2

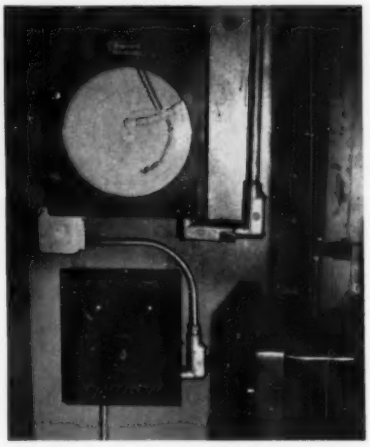
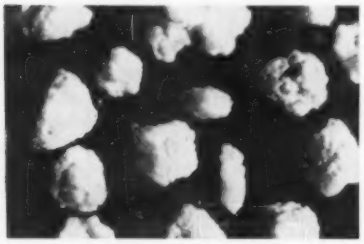


Fig. 3

Complete automation of heavy media processes, long an objective in coal and iron ore preparation, is reported achieved for the first time in an installation in the Pennsylvania anthracite industry.

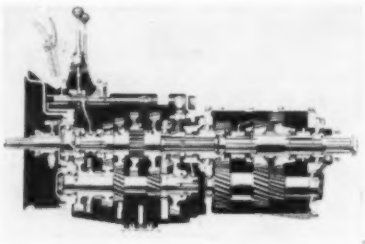
Specific gravity in heavy separation of anthracite coal is held to within ± 0.003 of set point at widest spread with closed loop control system at an installation at Lykens, Pa. Closed loop system, an industry first, is collaborative development of Wilmot Engineering Company, Brown Instruments Division of Minneapolis-Honeywell Regulator Company, and Industrial Nucleonics Corp. of Columbus, O. Basic principle revolves around use of gamma radiation to measure medium density. Fig. 1 shows AccuRay density unit mounted on heavy media pipe just ahead of manifold leading to Wilmot heavy media vessel. Specific gravity of flowing water-magnetite medium is measured by radiation absorption. Amount of radiation passing through medium to radiation detector (Fig. 2) is inversely proportional to mass. Electrical signals from detector are preamplified and read out on gravity meter with visual indicator. ElectroniK recorder-controller with Electr-O-Line proportioning unit charts specific gravity to ±0.001 and operates three control elements: motorized valve in media bypass line, motorized valve to admit water to system on high specific gravity reading, and Modutrol motor which operates Syntron magnetite feeder (Fig. 3). Controlling recording-ammeter above feeder measures amperage drawn by main belt feed coal conveyor, shutting down magnetite feed if amperage drop indicates no load. Circle No. 62.



New AN Pellets

Ammonium Nitrate in a new pellet form said to increase the economy and effectiveness of AN blasting is announced by the Atlas Powder Company.

Atlas pellets are described as the optimum size and shape for better control over borehole density and oil absorption. Their porosity allows them to readily absorb sensitizing agents such as fuel oil. The pellets flow freely and may be field-mixed by any method. Circle No. 94.



Heavy-Duty Transmissions

Two new heavy-duty 15-speed transmissions for heavy-duty truck service are being produced by Fuller Manufacturing Company. Designed for use in Diesel powered trucks and tractors in the 1120 cubic inch class, the new transmissions, models 15-G-1120 and 15-H-1120, are designed especially for combination on and off-highway applications such as aggregates, ready-mix concrete, logging and construction. Circle No. 95

Chain Sleeve-Clamp

A new, easily-mounted chain sleeve-clamp for attaching rubber sleeves at hydraulic pipe line joints is being manufactured and marketed by Black Bros. Co.

The heavy-duty clamp has extensive application in dredging operations, hydraulic mining and similar installations—wherever hydraulic pipe lines are joined by rubber sleeves to provide flexibility in hose. One size clamp serves all sizes of pipe, from 6 inches to 30 inches. Circle No. 91.

New Concept of Soil Stabilization and Grouting Proves Effective

An entirely new concept of soil stabilization and grouting by development of a chemical that turns water into a stiff continuous gel in a controlled period of time, has been announced by the American Cyanamid Company.

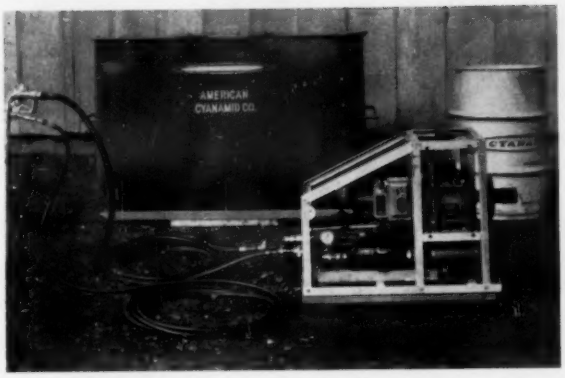
Known as AM-9 Chemical Grout, it was designed for application by means of a patented process in the mining and construction industries to prevent various types of water seepage.

The new product, seven years in development and field testing, is available as a dry white powder, and is applied in a non-viscous solution which will penetrate any mass through which water flows.

After the addition of a catalyst, an aqueous solution of AM-9 is injected or percolated through the soil or rock formation. Gelling time is controlled from a few seconds to several hours, depending on the type of catalyst used. The nature of the reaction is such that the viscosity of the solution remains essentially that of water until just before the gel forms.

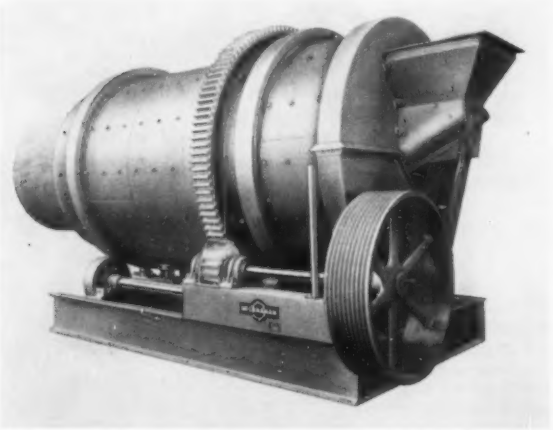
The gel not only prevents the passage of water through the mass, but also binds together the particles of soil, sand, or loose rock and provides a moderate increase in shear strength. Stabilized soils below the water table are believed to retain their properties permanently.

AM-9 has been successfully used to seal off the flow of underground water into oil wells, drill holes, industrial basements, tunnels, mine shafts, coffer dams, sewer pipe joints, caissons and open excavations, as well as to seal underground curtain walls in and around dams and dikes. It is particularly effective for solidifying weak, granular soil masses during tunneling operations, the sinking of caissons, and in many types of shafts and excavations. However, applications in which it is desired to increase the load bearing characteristics of soils are not recommended at this time.



In order for AM-9 to be effective and economical it should be applied by people who are trained in grouting technology and who have the proper equipment.

The equipment for applying the chemical generally consists of two positive displacement pumps designed to handle AM-9 solutions, and catalyst solutions separately. The pumps should have variable speed controls so that the solution volumes can be changed at will to vary gel time and AM-9 concentration. The two solutions are brought together and mixed at or near the injection point in a suitable fitting. Circle No. 65.



New Heavy-Duty Revolving Scrubbers

A newly developed line of revolving scrubbers for cleaning sand, gravel, crushed stone and various ores has been introduced by McLanahan and Stone Corporation. These McLanahan H-D Heavy-Duty Scrubbers will process fine and coarse feed simultaneously or will remove fine materials first, through use of a desander.

Designed for handling product sizes up to 8", H-D Scrubbers are made in three sizes: 6' x 12', for 60-120 tph capacities; 7' x 14', for 90-180 tph capacities; and 8' x 14', for 125-250 tph capacities. Capacities are based on 100 pound per cubic foot material. Special sizes, as required, also are available.

Features of the new scrubber line include: Locomotive steel tires, adjustable trunnion rollers and thrust rollers with renewable tires, dewatering screen extension, optional desander. Tire concentricity is assured through use of a specialized balancing technique. A choice of lifter shelves, plows and/or angled flights can be supplied for the interior surface of the shell. Circle No. 63.

Front-End Loader Has Many Features

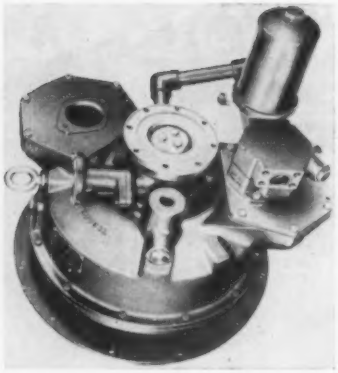
The new TL-1 front-end wheel loader by Allis-Chalmers features increased capacity and speed. The new four-wheel drive loader has a carrying capacity of 4,000 pounds and a static lifting capacity of 9,500 pounds.

The TL-12 has the power reversing Tractomatic transmission with a lever on the steering column to control both forward and reverse movement without stopping the machine to clutch and shift gears. This lever hydraulically engages the two multiple disc, dry-type clutches—one for forward travel and the other for reverse. The use of two clutches prolongs clutch life.

Four speeds forward are provided to 21.2 mph, and four reverse speeds to 27.9 mph. Reverse speeds are approximately 30 percent faster than the forward speeds in the same gear. This design permits a faster loading cycle without shifting to a higher gear to achieve the same effect.

The transmission, coupled with the TL-12's large 13 inch single stage converter having a 3 to 1 ratio, assures correct operating speeds for every job and condition.

The transmission also has an automatic clutch cut-off which disengages the clutch when the brakes are applied. This has the effect of placing the transmission in neutral, thereby diverting full engine power to the hydraulic system for faster loading and dumping. Circle No. 64.



Sumpless Torque Converters

For motor graders, front end loaders, tractors and other vehicles with power-shift transmissions, Twin Disc Clutch Company has developed a new line of sumpless torque converters. These are single-stage units furnished in three different input torque capacity sizes: 350 lb.-ft. (1300 series); 450 lb.-ft. (1500 series Standard Duty); and 650 lb.-ft. (1500 series Heavy Duty). Circle No. 96

Thermocouple Brochure

Metalic-sheathed, hard-packed, oxide-insulated thermocouples and extension wire are discussed and described in a new bulletin released by Research Instruments, Inc. of Cleveland, Ohio. Various hot junctions are illustrated and described by cutaway drawings. Also covered are various optional terminals, mounting attachments, fittings, materials and prices. Circle No. 11.

New Alarm Control System

A new system for checking and controlling remote, unattended functions of utilities, pipelines, railroads and similar operations is now available through the General Electric Company.

The alarm-control system reportedly may be used to monitor functions at as many as a hundred different locations, and ten functions may be checked at each point. Tone signals, transmitted by wire line, carrier current or microwave, indicate whether a certain pre-scheduled action is taking place or whether a fault has occurred.

At the control center, the rack-mounted tone equipment is connected by cable to a small console on the operator's desk. The console has a bank of indicator lamps to show the station being checked, and a second bank to reveal the presence of possible faults. Locations are selected and remote equipment is operated by means of a dial.

The tone equipment at the unattended location is mounted in standard relay racks. It requires only two panels 3½ inches deep, one containing the switching mechanism and the other the tone receiver and power supply. Circle No. 71.

Fertilizer Plants

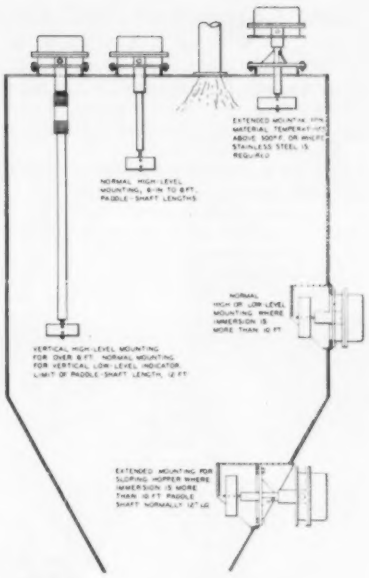
The J. C. Carlile Corporation of Denver, Colorado, has issued a new brochure, illustrated with photographs of existing plants, describing the Carlile processes for production of wet process phosphoric acid and ammonium phosphate fertilizers, including di-ammonium. Plant construction utilizes sectionalized design which provides a simplicity and economy available in no other way.

Schematic flow diagrams show the step-by-step production of phosphoric acid and ammonium phosphate fertilizers, including complex fertilizers. Plants described in the text range in capacities from 30 tons per day of P_2O_5 to 200 tons per day, and from five tons per hour of high analysis ammonium phosphate to 25 tons per hour.

Data included will act as a guide for new installations as well as increasing capacities of existing installations by sectionalizing. Circle No. 67.

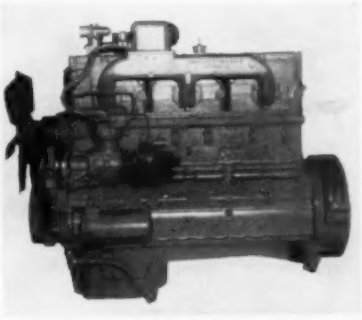
Space Saver

Compactly-designed ER-6 air compressor developed by Atlas Copco reportedly delivers 1,075 cubic feet of air per minute at 100 PSI. Designed for stationary or semi-portable use, the 6,600-pound machine is said to require only about half to two-thirds the amount of floor space needed for compressors with comparable output and also cuts full load consumption by from 10 to 15 percent. Circle No. 90.



Material-Level Indicators

Fuller material level indicators are now designed for hazardous dust locations, as well as for general purpose use, officials of Fuller Co. announced. The material level indicators may be used to indicate the level of pulverized, fine, crushed or granular materials (maximum 1-inch size) in bins and silos. Diagram above shows typical applications. Circle No. 73.



New Diesels Offer Economies

Cummins Engine Company announces three new large displacement Diesel engines for the international market. The new NHE-180, the NHE-195, and the NH-250 are rated at 180, 195, and 250 horsepower respectively. They are especially designed for economy, dependability and long engine life. The NHE-180 and NHE-195 offer more economy with better performance than previously available in this horsepower range. A number of important innovations have been incorporated in the completely new design of the NH-250. The clean appearance of the engine was obtained by making all fuel and lubricating oil lines drilled passages, eliminating external lines which reduce the chance of line breakage and downtime. Circle No. 55.

MORE NEW EQUIPMENT . . . AND NEW LITERATURE

FREE MANUAL on aluminum welding, brazing and soldering is offered by the All-State Welding Alloys Company. This comprehensive, 40-page illustrated booklet has chapters and charts devoted to all methods of aluminum joining. Circle No. 1.

ROTARY PORTABLE COMPRESSOR UNIT for mounting on the rear of a tractor has been introduced by Joy Manufacturing Company. Called the Joy Airvane RT-600 Rotary Compressor the 600 CFM unit mounts easily on the tractor and is driven through a rear power take-off. Circle No. 2.

FREE ILLUSTRATED BOOKLET on high-alloy heat and corrosion-resistant castings has been published by the International Nickel Company. This 64-page booklet is designed as an aid to those interested in stainless steel and high-alloy casting selection, design and production. Circle No. 3.

DIAMOND BITS AND CORE BARRELS are the subject of a new 28-page bulletin available from the Acker Drill Company. This illustrated bulletin describes their complete line of diamond bits, core barrels, rotary rock bits and drag type bits. Circle No. 4.

PRODUUCTS FOR THE PLANT is the title of a new booklet just published by Ingersoll-Rand. This 8-page booklet details information on compressors, pumps, hoists, air and electric tools and other plant equipment. Circle No. 7.

VIBRATING BALL MILL has many applications over conventional roller mill according to Allis-Chalmers Manufacturing Company. A saving in initial cost and maintenance plus easily replaceable wearing parts are features of this mill. Circle No. 8.

RUBBER HOSE: A new 24-page catalog just released by Mercer Rubber Company contains complete descriptions on over 35 specific types of hose. Circle No. 9.

CLASSIFIERS are described in a new 28-page Catalog No. 601 recently published by Mine and Smelter Supply Company. Includes complete information on principle of operation, construction details, capacities, etc. of Akins Spiral Classifiers. Circle No. 10.

PNEUMATIC TRANSPORT: Elevation of solids can be accomplished while drying and/or cooling to eliminate separate dryers and/or coolers and elevators. These systems are specially designed for each application by Silver Engineering Works, Inc. Circle No. 12.

GEOPHYSICAL KIT to scientifically prospect for all types of mineral deposits has been developed by Sharpe Instruments of Canada. The equipment may be carried comfortably on the prospector's back and has been designed to take considerable abuse and still function properly. Circle No. 13.

WARN HUBS: Two new models of Warn "selective drive" hubs for the new Chevrolet and GMC ½ and ¾ Ton Spicer axle 4-wheel drives are now available by Warn Manufacturing Company, Seattle, Washington. Other models of Warn Locking Hubs are available for Napco conversion front drive units on Chevrolet and GMC, and Marmon-Herrington conversions. Circle No. 14.

WIRE ROPE: A new wire drawing technique gives Wickware Double Gray-X wire rope extra long life and extra strength according to the Colorado Fuel and Iron Corporation. By using molybdenum disulphide in the drawing process many advantages are obtained. Circle No. 15.

VENTILATION TUBING that is wire reinforced, using sturdy fabrics that are neoprene coated on both sides to resist friction and make airtight, is described in Bulletin 360 recently released by the American Brattice Cloth Corp. Circle No. 16.

NEW 9-TON DUMPER that features a 113 horsepower engine, two-way steering, four forward and two reverse speeds, a 10-second hydraulic tip, and is reportedly equipped for the toughest off-highway duties is described in List No. 1818 by Aveling-Barford Limited of England. Circle No. 17.

CONTROL SYSTEM for conveyor belt feeding, blending, and proportioning is detailed in Bulletin 57-A by the Industrial Physics and Electronics Co. CON-O-WEIGH is a highly accurate continuous belt scale for weighing free-flowing bulk materials. Circle No. 18.

ROTARY BLAST-HOLE DRILLS are described in Bulletin 341-8 by the Joy Manufacturing Company. Four models in the Champion line are available with capacities from 5⅜ inches to 12¼ inches hole size. Circle No. 19.

DIAMOND BITS are covered in special Catalog No. 320-1 just released by Sprague & Henwood, Inc. The right bit for the right job is the theme of this free diamond bit story. Circle No. 20.

AIR SEPARATORS: Bulletin No. 087 describes Sturtevant separators which classify sand without water. The text points out that pre-classification by air can increase screening production by removing screen blinding fibers. Circle No. 21.

ROCK SCREENS for heavy duty performance that screens ore at low cost per ton are described in Catalog 68 by the W. S. Tyler Company. For a free copy circle No. 23.

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JUNE 1960 — **NOT GOOD IF MAILED AFTER JULY 25**

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31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	81	82	83	84	85	86	87	88	89	90
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FLOTATION REAGENT: The Pacific Lumber Co. announces a price reduction of 1½ cents a pound for Palcotan, the sodium salt of sulfonated complex organic acids, used as a depressant in flotation circuits. Circle No. 40.

DOUBLE IMPELLLER IMPACT BREAKER made by the Iowa Manufacturing Co. is portable and now features the Simplicity Grizzly Feeder. This CEDARAPIDS model now combines into one compact unit, a grizzly to bypass fines and undersize material, and a feeder which reportedly assures a positive uniform flow of material. Circle No. 41.

ELECTRIC MOTORS: Lincoln Electric Co. announces its line of 3-phase, squirrel-cage induction motors has been expanded to include sizes from ½ to 125 hp. and incorporate several design modifications. Circle No. 42.

MOTOR SHIELDING: Sterlicone Shielding, a permanently resilient insulation developed by Sterling Electric Motors, Inc. to form a smooth, flexible stator coil encasement, is now available on Sterling Speed-Trol Variable Speed Drives and Sterling Slo-Speed Gear Motors. Circle No. 43.

ENGINE down time . . . and engine overhauls are costly. A new 6-page leaflet by Caterpillar Tractor Co. outlines steps that can be taken to minimize downtime and stresses importance of using manufacturers parts to assure maximum service life. Circle No. 44.

RUBBER GRAPH STAMP is the latest engineering convenience from Edmund Scientific Co. A clear, sharp, 3-inch square graph pattern can now be stamped in notebooks, reports, records, letters, etc. Circle No. 45.

CABLE CUTTER and crimper for cutting large electric cables in confined quarters is available from the Welsbach Corporation. Circle No. 47.

NEW WELDING UNIT designed to resurface larger rollers, idlers, wheels, etc. up to 40 inches diameter developed by Automatic Welding Co. Circle No. 49.

GASOLINE ENGINE: Allis-Chalmers Mfg. announces the G-138, a 4-cycle, 4-cylinder, 138-cu. in. displacement unit that develops 39 hp at 1,800 rpm. Circle No. 50.

CRAWLER TRACTOR time and motion studies by J. I. Case Co. shows in 30-minute sound and color motion picture side-by-side field comparisons of all leading makes of crawlers. Circle No. 51.

SELF-PROPELLED SCRAPER by J. I. Case Co. has 6.5 cu. yd. heaped capacity. Powered by Case 80 HP diesel, it features torque-converter drive and 8-speed transmission. Circle No. 52.

NEW ANGLEDOZER by Balderson, Inc. increases usefulness of the #944 Caterpillar Traxcavator by mounting on lift arms in place of the bucket. Circle No. 53.

NOTCHED V-BELT of unique fully molded design is said to offer quiet, vibrationless running characteristics plus ruggedness and greater flexibility. Raybestos Manhattan, Inc. states new notched V-Belt outlasts other belts 8 to 1. Circle No. 54.

EXCAVATOR LOADER AND ROCKER SHOVELS made by Eimco Corp. now incorporate a recently patented rocker arm rail which reportedly permits filling bigger cars with less headroom in mines and tunnels. Circle No. 56.

FLAME SPRAY PROCESS bulletin by the Metallizing Engineering Co. provides engineering data on coatings of metals, ceramics, carbides and other high melting point materials. Circle No. 22.

NEW POWER SHOVEL on crawlers with special outriggers with 30-ton lift capacity has been announced by Koehring Company. The 330 "Sprawler," said to be able to lift 2½ tons more than its own working weight, is described in a 6-page brochure. Circle No. 24.

ELECTRIC GENERATING PLANT, designed specifically for home standby service has just been announced by D. W. Onan & Sons Inc. This compact, completely self-contained, remote-starting unit provides 2500 watts and is available in two different outputs. Circle No. 31.

NEW MAGNETIC PULLEY with magnetic poles parallel to the shaft separates large or small iron contamination according to recent booklet issued by the Eriez Manufacturing Co. New model maintains a magnetic field of great strength close to pulley and of great force across its whole width. Circle No. 32.

CABLE-WAY TROLLEY with a 125-pound capacity has been added to the present line of 80, 160 and 250-pound trolleys available from American Cable-Way Conveyors. Circle No. 33.

BELT CONVEYOR IDLER: New Limberoller idler is described in 20-page Bulletin LD-111 by Joy Manufacturing Co. Idler consists of series of neoprene discs molded to neoprene-covered, flexible wire cable suspended from two end-mounted bearings. Circle No. 34.

SOLID LUBRICANT sample and brochure are offered by Alpha-Molykote Corp. describing wide industrial application of their grease consistency lubricant Molykot Type G, said to reduce galling, seizing, and metal pickup in high pressure and temperature applications. Circle No. 35.

PORTABLE SCREENING UNIT, termed the Porta-Screen, for size-testing blacktop and concrete aggregates, ores, and similar materials has been announced by the Gilson Screen Company. It reportedly handles samples up to 25 lbs. in a range of 1½-in. to 200-mesh. Circle No. 36.

V-BELT CATALOG is available from the Boston Woven Hose & Rubber Co. General Information, V-Belt drive selection tables, horsepower rating tables and matching data, plus other product information is included in this new 64-page catalog. Circle No. 38.

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Metal & Mineral Prices

U.S.A.

METALS

May 20, 1960

COPPER: **Electrolytic.** Delivered F.o.b. cars, Valley basis (pound) ..... 33.00¢
Lake. Delivered, destinations, USA ..... 33.00¢
Foreign. Delivered, destinations, USA ..... 33.00¢
Custom ..... 33.00¢
LEAD: **Common Grade.** New York (Per pound) ..... 12.00¢
Tri-State Concentrate, 80% lead, per ton $141.72
ZINC: **Prime Western:** F.o.b. E. St. Louis (Per Pound) ..... 13.00¢
Prime Western: Delivered New York ..... 13.50¢
Tri-State Concentrate, 60% zinc per ton $80.00
ALUMINUM: **Primary 30 Pound Ingots (99.5% plus)** (Per pound) 28.10¢
ANTIMONY: Lone Star Brand. F.o.b. Laredo, in bulk (Per pound) 29.50¢
BISMUTH: (In ton lots) price per pound **$2.25**
CADMIUM: **Sticks and bars.** 1 to 5 ton lots Price per pound .. $1.50
COBALT: **97-99%,** keg of 550 pounds (Price per pound) $1.50
COLUMBIUM: **Ingot** ..... Nom., per pound $55.00-$85.00
GERMANIUM: dioxide, high purity, gram ..... **18.50¢**
LITHIUM: **98%** (per pound) ..... $9.00-$12.00
MAGNESIUM: **Ingots (99.8%)** F.o.b. Velasco, Texas per pound 36.00¢
MERCURY: **Flasks.** Small lots, New York ..... $213.00-$215.00
NICKEL: "P" Ingots (5 pounds). F.o.b. Port Colbourne, Ontario **75.50¢**
PLUTONIUM: To July 1 1962 AEC will pay $30.00 to $40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram **$30.00**
SELENIUM: 99.5%, per pound **$7.00**
TELLURIUM: Common grade, Per pound $3.00
THORIUM: **per kilogram** **$43.00**
TIN: **Grade A Brands.** New York (Per Pound) Prompt delivery 99.50¢
TITANIUM: **99.3%** + Grade A-1 Sponge (Per pound) .. $1.50-1.60
URANIUM: Rod (0.790 U-235) $16.00 Per Pound; Foil **$16.75**
U-235: Nominal (Per pound) **$7,725**
GOLD: United States Treasury Price ..... **$35.00 per ounce**
SILVER: Newly mined domestic. U.S. Treasury price per ounce 90.5¢
Foreign Handy Harmon ..... 91⅜¢
PLATINUM: Per ounce ..... $82.00-$85.00
ZIRCONIUM: **Sponge,** Per pound, Reactor Grade $5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: 10 to 12% BeO. F.o.b. mine, Colorado $46.00 per unit Small lot purchases at Custer, S. D., Spruce Pine, N. C.,and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $48.00.
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons.
African (Rhodesian). 48% Cr_2O_3. 3 to 1 Ratio .... $35.00-$36.00
African (Transvaal). 48% Cr_2O_3. No ratio ..... $28.00-$32.00
Turkish, 48% Cr_2O_3. 3 to 1 chrome-iron ratio Nominal $36.00-$37.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.
COLUMBIUM-TITANIUM ORE: Per Pound Pentoxide Nominal $1.10
IRON ORE: **Lake Superior. Per gross ton Lower Lake Ports**
Mesabi, Non Bessemer, 51.5% Fe **$11.45**
Mesabi, Bessemer, 51.5% Fe **$11.60**
Old Range Non Bessemer **$11.70**
Old Range Bessemer **$11.85**
Lump: Plus ½-inch $12.85
Fines: Minus ½-inch $10.72
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit ..... $24.00-$25.00
MANGANESE ORE: **Metallurgical grade. 48 to 50% Mn** Long ton unit ..... $0.95-$1.00
Metallurgical grade. 46 to 48% Mn. Long ton unit ... $0.90-$0.95
Metallurgical grade. 44 to 46% Mn. Long ton unit ... $0.85-$0.90
Domestic U.S. Government. GSA Basis $2.30 per unit for 48% mn.
MOLYBDENITE CONCENTRATE: **90% MoS_2 F.o.b.** Climax, Colorado. Per pound Mo, plus container cost $1.25
TUNGSTEN CONCENTRATE: **Domestic. 60% WO_3 Per short** ton unit ..... Nominal $24.00
Foreign: 65% WO_3 Per short ton unit (Scheelite) ... Nominal $19.00
Foreign: South American, Spanish, Portuguese ..... Nominal $19.00
URANIUM ORE. F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is **$1.50 per pound of U_3O_8 in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.**

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum **4.25 specific gravity,** per short ton $16.00
BENTONITE: Minus-200mesh. F.o.b. Wyoming. Per ton, carload lots $12.50
Oil Well grade. Packed in 100 pound paper bags $14.00
BORON: technical grade .. F.o.b. Boron California. Per ton $47.50
FLUORSPAR: **Metallurgical grade. 72.5 % effective CaF_2** content per short ton F.o.b. Illinois-Kentucky mines ... $37.00-$41.00
Mexican. 70% F.o.b. border ..... **$26.00-$27.00**
Acid Grade. 97% CaF_2, Bulk, F.o.b. mine ..... $45.00-$49.00
PERLITE: Crude: F.o.b. mine per short ton ..... **$3.00 to $5.00**
Plaster grades. Crushed and sized. F.o.b. plants .... **$7.00 to $9.00**
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas ... $22.50-$23.50

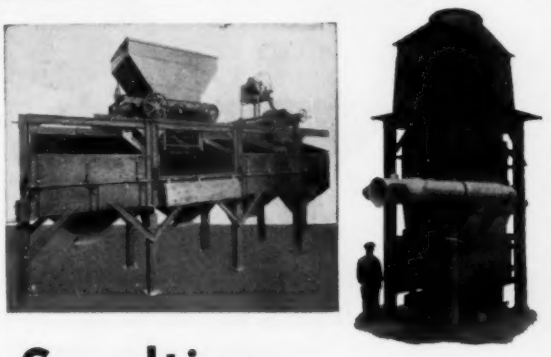
London

May 20, 1960

		Per Long Ton	USA Equivalent cents per pound*	
COPPER:	**Electrolytic spot**	£243	0s 0d	30.38¢
LEAD:	**Refined, 99%**	£ 77	2s 0d	9.64¢
ZINC:	**Virgin 98%**	£ 91	15s 0d	11.47¢
ALUMINUM:	**Ingot, 99.5%**	£186	0s 0d	23.25¢
ANTIMONY:	**Regulus, 99.6%**	£197	10s 0d	24.69¢
TIN:	**Standard, 99.75%** ...	£784	0s 0d	98.00¢
TUNGSTEN:	**Long ton unit**	149s		$20.86¢

*With Sterling Pound at $ 2.80

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, N. Y.*



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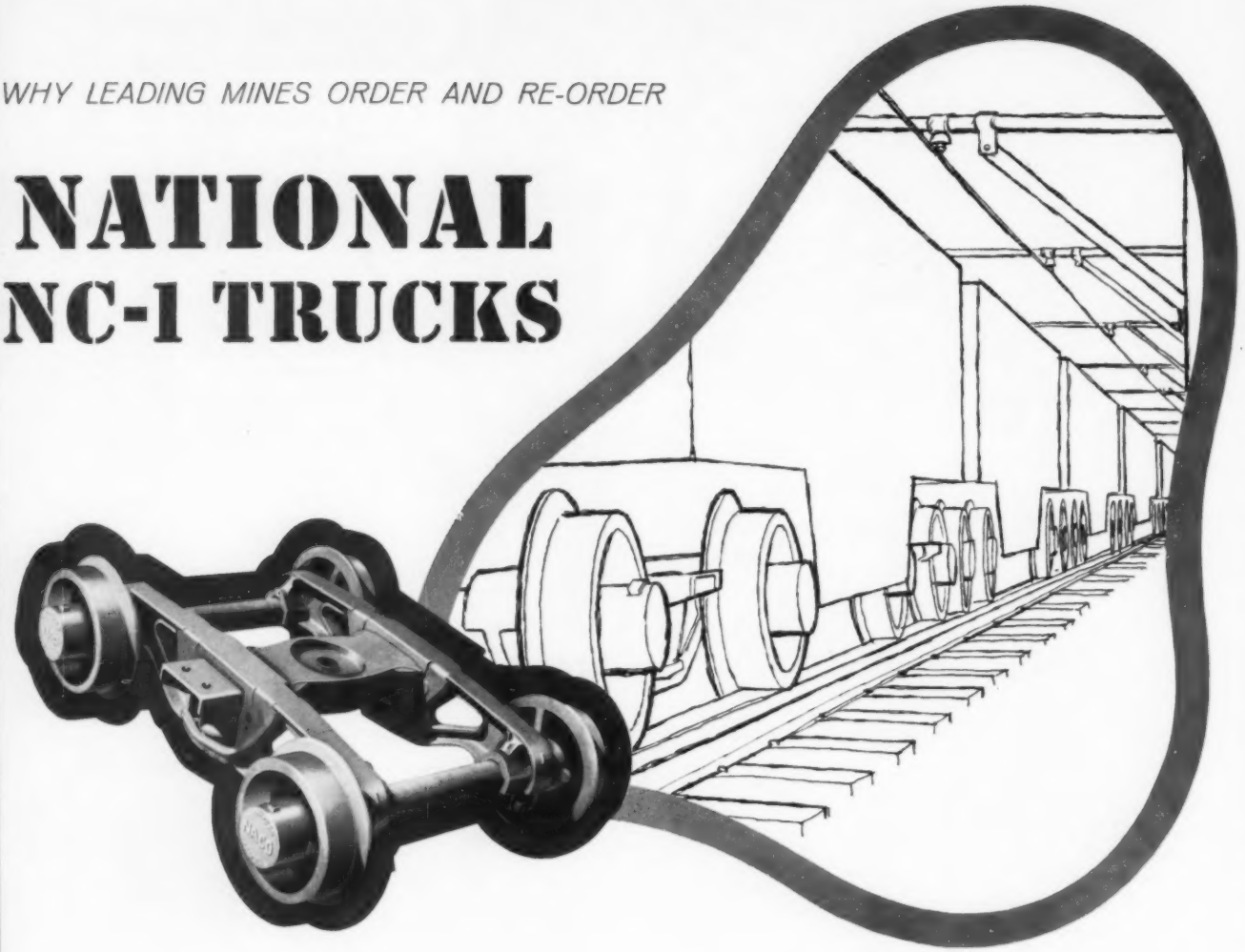
WHY LEADING MINES ORDER AND RE-ORDER

NATIONAL NC-1 TRUCKS



The reasons for the decided swing to National NC-1 Trucks are fundamentally two: they provide safety to personnel and equipment... they make money for mine operators. There are lots of technical reasons, too. Let our representatives tell you all about them.

A-1792A

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RUBBER CUSHIONING DEVICES
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NACO STEEL WHEELS
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MALLEABLE AND STEEL
CASTINGS COMPANY

Cleveland 6, Ohio

WHAT'S GOING ON IN MINING

Tri-State Zinc to Develop Mine in Tennessee for American Zinc

An agreement between American Zinc Lead and Smelting Company and Tri-State Zinc Company, announced jointly by the two firms, will accelerate development and mining on a tract of mineral lands near New Market, Jefferson County, Tennessee. American Zinc will make available to Tri-State, for development and mining, its property where diamond drilling indicates an ore reserve estimated as large enough to produce 1,000,000 tons of high-grade zinc concentrate.

Tri-State will complete development by further drilling to prove the indicated reserve and then start sinking shafts or inclines to bring the mine into production as soon as possible. Simultaneously with the mine development, a concentrating plant with a daily capacity of 3,600 tons will be built by Tri-State, which is a wholly owned subsidiary of Gold Fields American Development Company Ltd., in turn a subsidiary of The Consolidated Gold Fields of South Africa Ltd. of London. Tri-State is an efficient zinc miner in Illinois and Virginia.

American Zinc will supply ore to the new mill from its own mines while the Tri-State development project is under way. All concentrates produced from the property involved will be made available to American Zinc for use at its plants in Illinois, Arkansas, and Ohio.

Tri-State's total investment in the project will be between $3,000,000 and $4,000,000. Estimated production when mine development is completed is 35,000 to 40,000 tons of zinc concentrate per year.

American Zinc has located a substantial tonnage of zinc in the East Tennessee district during the last five years, of which the indicated tonnage in the tract covered by the Tri-State agreement represents about 20 percent.

University of Arizona Plans Fall Symposium on Surface Mining

The University of Arizona College of Mines, noted for its excellent symposia, has announced plans for one on Surface Mining Practices, to be held next October 17 and 18. This conference will be of special interest to the mining industry as the last one on Fluid Bed Reactors was to metallurgists. (See special report in MINING WORLD, April 1959, pages 25-33.)

Tentative program subjects for the Tucson conference include Open Pit Mining—metallics and non-metallics; Strip Mining—phosphates, coal, etc.; Quarrying—limestone, gypsum, etc.; Transportation—equipment; Drilling and Blasting, and several miscellaneous topics.

Additional information may be obtained by writing to Professor H. G. Krumlauf at the college.

Illinois-Wisconsin Zinc-Lead District Becomes More Active

The Eagle-Picher Company's Linden Unit mill at Linden, Iowa County, Wisconsin, is being reopened after closure because of low zinc prices. The 400-ton-per-day mill was built by Davis Mining Enterprises under an R.F.C. loan and purchased by Eagle-Picher. Ore is being mined by the company from adjoining leases and hauled by truck from the face via inclined adit to the mill.

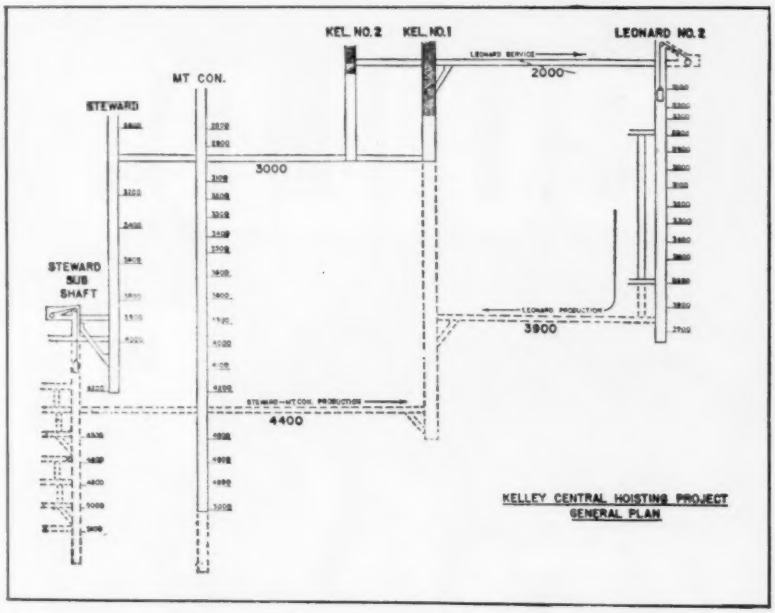
In addition to the Linden mill, the Illinois-Wisconsin operations of the company's Mining & Smelting Division include the 1200-ton-per-day Shullsburg unit mill, four miles south of Shullsburg, Wisconsin, purchased from **Calumet & Hecla**; and the 1600-ton-per-day Graham mill, five miles north of Galena, Illinois, built by the company.

At the Graham mill ore processed from the Graham-Snyder-Ginte ore body is truck-hauled underground and skip-hoisted through a vertical shaft. The O'Rourke, a mile north of the Graham, is a new ore body opened to a depth of 200 feet by inclined adit. The Birkett unit, seven miles northeast of the Graham, is a group of old mines including the Birkett, Brynes, and North Monmouth originally mined by Vinegar Hill Zinc Company, that have been opened by inclined adit and cut together underground. Ore from the "satellite" O'Rourke and Birkett units is loaded at the face into contract carrier trucks and hauled without transfer to the Graham mill. Further tying together of old mines in the Birkett unit area is planned.

Ore for the Shullsburg mill, from contiguous ore bodies tied together by drifts and crosscuts, is truck-hauled underground and skip-hoisted through a vertical shaft. In all mining operations wide use is being made of rubber-tired loaders.

Robert Haffner is resident-manager of Eagle-Picher's Illinois-Wisconsin operations with offices at Galena, Illinois.

An act that regulates underground use of Diesel internal combustion engines, passed by the last Arizona State Legislature, goes into effect June 25, when Roy V. Hersey, state mine inspector, will issue regulations on the subject. The legislation provides that written permission must be issued for every such installation, and that operation of designated equipment continue only so long as it is operated and maintained in accordance with recommendations made by the state mine inspector. When safe conditions of air quality are not maintained, operation shall cease until such conditions are corrected. The standards, according to Mr. Hersey, will undoubtedly be high and rigidly enforced.



Anaconda Starts Centralizing Deep Mining at Butte

An $11,000,000 development program that will tap high grade copper ore reserves at deep levels and assure successful vein mining operations in the Butte, Montana area for decades to come has been started by the Anaconda Company. Most important such project in the area for many years, the five-year plan calls for extending the Kelley No. 1 shaft to make it a central hoisting shaft that will bring ore from deep levels of the Mountain Con, Steward, and Leonard mines. The ore will be trammed through large haulageways established from the Kelley to the Mountain Con and the Steward mines on the 4,400-foot level and to the Leonard on the 3,900-foot level. The Leonard, shut down since 1958, will be reactivated, as will the Belmont mine, also to be connected eventually with the Kelley haulage and hoisting system. The Tuolume shaft is being enlarged and concreted to make it the central pumping shaft for removing water from all the mines, replacing the High Ore pumping station.

KELLOGG ENGINEERS AND BUILDS FOR KENNECOTT

KENNECOTT'S NEW $30-MILLION COPPER REFINERY DEMONSTRATES KELLOGG'S ECONOMIC APPROACH TO PLANT ENGINEERING, PROCUREMENT, CONSTRUCTION

Kennecott's new plant in Anne Arundel County, Maryland, is the newest and most modern electrolytic copper refinery in the United States. A model of efficient and economical execution, it is the result of close teamwork between Kennecott Refining Corporation and The M. W. Kellogg Company—to whom Kennecott assigned over-all responsibility for engineering, procurement, and construction.

This $30-million project demonstrates how large and complex plants can be designed and built for the optimum *predetermined* investment when all phases of the job are integrated into one unified operation by a single contractor. The method and the results are typical of the way Kellogg has worked with leading oil refiners, chemical companies and ore beneficiating firms.

Many design and engineering innovations resulted from this relationship. Among them were various ways to facilitate materials handling and expedite product flow. These included: a specially designed automatic anode take-off machine; straddle trucks for moving cathodes; and semi-automatic bundling for copper billets. Plant construction also was speeded by Kellogg, and erection costs cut, by production-line pouring—right in the plant—of 1,000 huge concrete cells, and by training workers on the spot to fabricate over 95,000 feet of plastic pipe at the plant site.

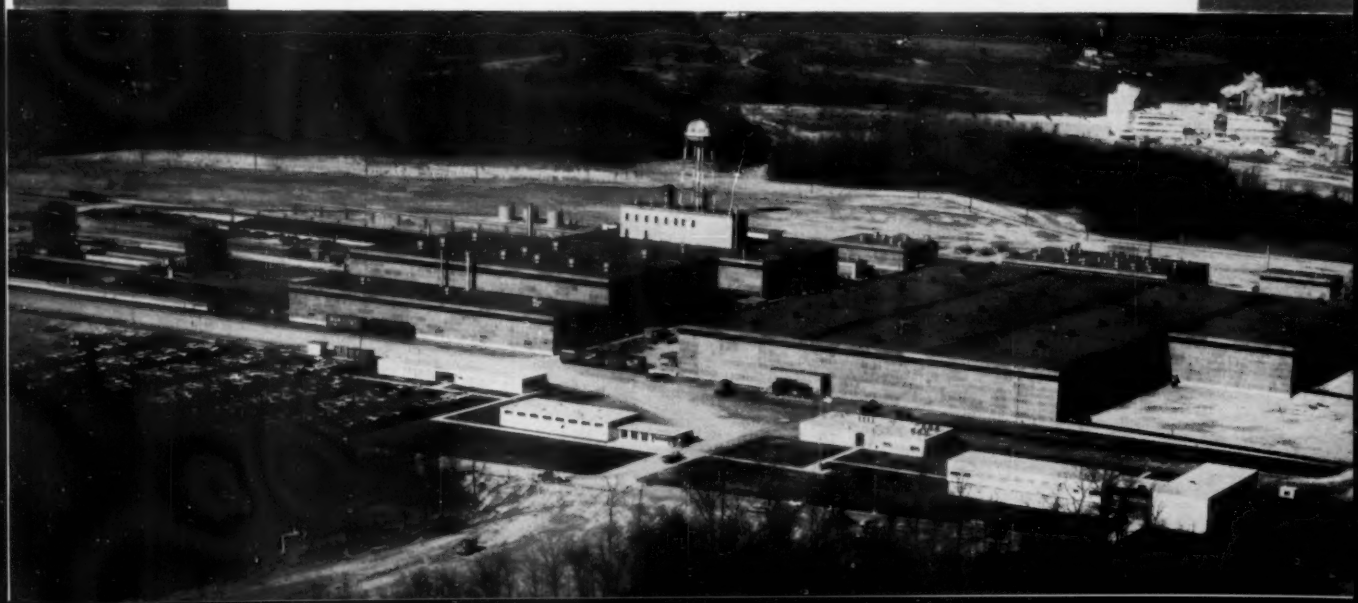
The complete story of Kellogg's engineering-procurement-construction assignment for Kennecott is available to you in a 12-page folder. You are also invited to send for Kellogg's brochure—"Planning the New Plant for Profits".

THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17

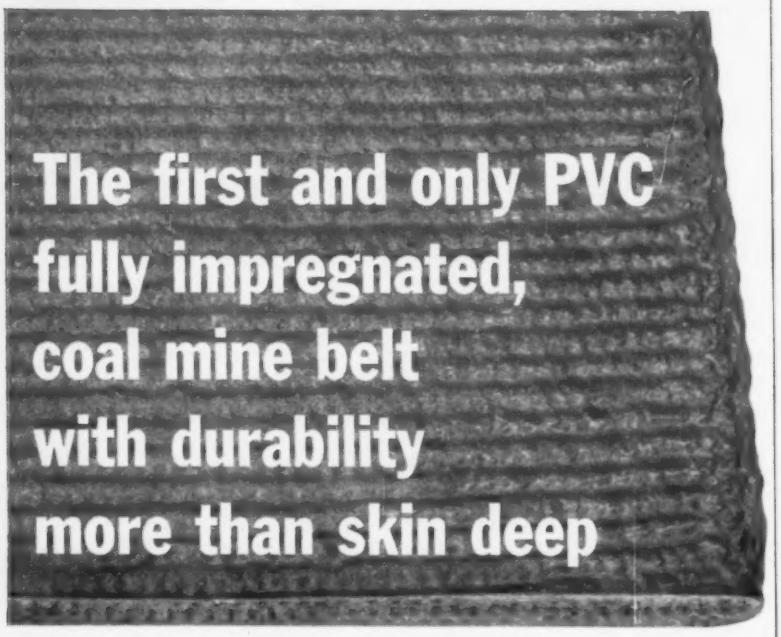
A SUBSIDIARY OF PULLMAN INCORPORATED

Offices of Kellogg subsidiary companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

Below is the new electrolytic copper refinery of Kennecott Refining Corporation (a subsidiary of Kennecott Copper Corporation) in Anne Arundel County, Maryland. Engineered and built by The M. W. Kellogg Company, this plant is expected to have a monthly capacity of 16,500 tons of 99.95% purity copper by mid-July.



Quaker Thermoid INTRODUCES REVOLUTIONARY "PLASTICOAL"



All the disadvantages of short life, slippage, stretching and rotting of conventional light-weight coal mine belts have been overcome by the revolutionary Thermoid-Quaker "Plasticoal" belt.

In contrast to conventional double-woven cotton fabric covered with neoprene, new "Plasticoal" is impregnated through and through with Polyvinyl Chloride . . . even the yarn is PVC dipped before it is woven. Nylon cords are added, in both directions, to provide extra strength and the entire impregnated carcass is heat-set under tension before the final dip and heat-set.

For underground mine safety, USBM 28-11 "Plasticoal" is flame retardant and flame resistant. It's lighter in weight and more flexible for ease of handling underground. The rough surfaces give better material traction, less slippage, yet require less tension. And being completely impregnated with PVC, the "Plasticoal" carcass carries the load long after the cover is worn away. Even extreme edge wear will not put "Plasticoal" out of commission.

Mine-orange "Plasticoal" is available from stock in 26″, 30″ and 36″ widths, up to 600′ lengths or longer on request. See your Thermoid Division Distributor for all the advantages of new "Plasticoal." Or write *Thermoid Division, H. K. Porter Company, Inc., 200 Whitehead Road, Trenton 6, New Jersey.*

THERMOID DIVISION

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H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

UNITED STATES NEWS

Shattuck Denn Mining Company at its **Iron King** mine, Humboldt, Arizona, mined 330,456 tons of ore in 1959 to produce 58,320 tons of concentrate with a content of 34,838,503 pounds of zinc; 12,068,100 pounds of lead; 468,981 pounds of copper; 26,837 ounces of gold, and 862,780 ounces of silver. The metallurgical research program of the company includes investigation of processes to utilize pyrite, most of which is now stockpiled.

L. E. Town of Globe, Arizona has developed a new method of processing, refining, and grading asbestos fiber. After 10 years of experimenting, he has filed for a patent on a machine that refines asbestos fibers through a combination of water, acid, and air pressure for fiber separation, and an unusual "finger-lift" means for more efficient grading. The machine is said to provide an asbestos-refining method that is economical, efficient, and capable of high production of a more valuable product from asbestos ore.

Jaquays Mining Corporation of Globe, Arizona, plans to build a hydrochloric acid treating plant to clean two to four tons of asbestos fibre a day. Construction is expected to start shortly at the company's present mill site, three miles east of Globe. Cleaning asbestos with acid dissolves impurities of lime, dust, etc. and doubles the market price of the fibre.

Mineral lease rights of half the San Carlos Apache Indian Reservation in Arizona are being assumed by **San Carlos Exploration Company** of St. Paul, Minnesota. **Hunting Geophysical Services Inc.,** which began an intensive airborne and ground survey at San Carlos late last year, is now undertaking the third phase of the project. The 1,600,000-acre area located in Gila and Graham counties, is known to contain deposits of asbestos and iron ore.

The **Ray Mines Division of Kennecott Copper Corporation,** which operates an open-pit copper mine at Ray, Arizona, and a concentrator and smelter at Hayden, received two safety trophies at the recent Arizona State Mine Inspector's Award Dinner in Phoenix. Robert Winkle, pit production superintendent, accepted the "Open Pit Award," earned for having the least number of lost-time accidents during 1959, compared to other open pit mining operations in the state. Cecil Fleming, division safety engineer, accepted the "Performance Award," which went to the mining and concentrating department for the best overall improvement in safety performance in 1959, compared with the preceding three years.

Work at **Inspiration Consolidated Copper Company's** smelter at Inspiration, Arizona, has been resumed after a two-week shutdown which was required for clean-up work prior to the transfer of the plant from **International Smelting and Refining Company** to Inspiration Consolidated. Purchase price of the plant and equipment was $1,350,000. In the future the smelter will treat concentrates and cement copper from the Inspiration mine as well as concentrates to be produced at the Christmas property, and the concentrates and ores from other producers. Efforts will be made to increase the custom tonnage. During 1959, Inspira-

tion mined 5,378,848 tons of ore and 3,993,262 tons of waste; the ratio of waste to ore being 0.74. The ore had a total copper content of 0.858 per cent, and recovery amounted to 15.72 pounds of copper per ton of ore treated. Total copper production—from ores and in-place leaching—was 94,023,162 pounds, compared to 83,641,275 pounds in 1958. Molybdenum recovery was 380,347 pounds of molybdenum, contained in molybdenite concentrate. Inspiration's 1959 operations were at capacity, with the mine working six days per week, and the metallurgical plants working seven days per week. H. Carroll Weed is general manager; Carl G. Stunz, assistant general manager; and Abner H. Neal, general superintendent.

The Chilson Mining Company, headed by R. E. Chilson of Tucson, Arizona, has a small crew employed in preliminary work at the old **DeSoto** mine, not far from Mayer, Arizona. The company proposes to mine the old pillars and fringe material in the upper part of the mine, then recover the copper by a modified form of heap leaching. The ore will be broken up, pushed into the old glory hole, then leached by water percolation, with precipitation of the pregnant solution in launders in the tunnel.

Approximately 2,500 tons of ore per month are being mined and milled by the operators of the **Flux** mine and **Trench** mill in the Harshaw district of Santa Cruz County, Arizona. A crew of 37 men is employed, 29 in the mine, working one shift; six in the mill working two shifts; and two in the shops. The operation is directed by E. W. McFarland, Nogales, Arizona.

G. W. Williams, Geneva, New York, owner of the **Oro** mine in the Oro Blanco district of Santa Cruz County, Arizona, has authorized the unwatering of the mine's 340-foot Julia shaft. Reports indicate that the shaft is bottomed in a good grade of ore, Williams said. H. Clyde Davis, Tucson, Arizona, will direct the work.

The **McCracken Mountain Mines Company** is the name of the reorganized company working the **McCracken** mine, near Yucca, Arizona. The officers are said to be the same as for the former operator—**Arivada Company.** Since the first of March, the company has been operating its mill on a three-shift basis, following a smaller scale of operations than since the start-up the first of January. The present mill feed is coming from an open cut above the Blacksmith workings at the north end of Mt. McCracken, and two carload shipments of concentrates have been made. Percy Ramsden is mine manager.

Production at the **New Cornelia Branch** of **Phelps Dodge Corporation,** Ajo, Arizona, in 1959 totaled 141,898,478 pounds of copper, compared to 109,857,376 pounds in 1958. For the year, the tonnage moved from the Ajo open-pit mine was 24,883,000 tons—an average of 78,995 tons per operating day. Of this, 9,823,000 tons were ore and 15,060,000 tons were waste; or a waste to ore ratio of 1:53 compared to the 1958 ratio of 1:78. The concentrator treated 9,803,000 tons of ore, or an average of 31,120 tons per working day. As no strike occurred during 1959 at the New Cornelia Branch, operations there were carried on in a normal fashion throughout the year. At the company's smelter at Douglas, Arizona, construction has been started on a small plant for the manufacture of sponge iron from iron oxide produced in the smelting operations. Previous experimental work is said to indicate that the sponge iron will be a more economical material for use in the precipitation of copper in leaching operations.

The Burro Claim, near Dragoon, Arizona, is being operated under lease by **Strong and Harris, Inc.,** of Vanadium, New Mexico, Ira L. Mosely, manager. This is an open-pit operation, producing about five carloads of high silica ore daily. The ore is trucked to Dragoon for shipment by rail to the Phelps Dodge smelter at Douglas for use as silica flux.

Repairs to the Republic mill of the **Coronado Copper and Zinc Company,** near Dragoon, Arizona, have been completed and the plant resumed a regular milling schedule the first week of March. The repairs included rebuilding eight flotation units, the installation of two new pumps and replacement of two reagent feeders. Production from the mine is running at the rate of 225 tons daily, or about 6,500 tons per month, the ore reported to average about 2.6 percent copper and 6.9 percent zinc, all sulphides. The ore is mined from one large stope, extending from the 400-foot level to the 500-foot level. It is dropped down to the 600-foot level, from which point it is hoisted up the Moore shaft, then trucked to the Republic mill for concentration. Lessees and operators of both the mine and mill are **McFarland and Hullinger** of Tucson, Arizona. In charge of local operations are W. D. Nelson, superintendent; G. H. Stoffers, mine foreman; K. L. Erickson, mill superintendent; Jesus Alvarez, mill foreman; Ralph Peterson, chemist, and Forrest Baker, purchasing agent.

McFarland and Hullinger, Tucson, Arizona, are closing their Sahuarita mill. This plant had been milling the ore from the **Coronado Copper and Zinc Company's property,** near Dragoon, but with the completion of repairs at Coronado's Republic mill that source of ore supply is no longer available. McFarland and Hullinger are lessees and operators of the Coronado property.

Julian Nickel Mines with George Freeman of Casa Grande, Arizona as manager, is mining a quartzite with low silver values at the **Orizaba** mine, southwest of Casa Grande, for shipment to the New Cornelia smelter of **Phelps Dodge Corporation** at Ajo. The present work consists of bulldozer-opened pit with a working face 150 feet in length and 10 to 20 feet high.

Duval Sulphur and Potash Company is milling about 11,500 tons of ore per day from its **Esperanza** mine, near Tucson, Arizona, with the mill operating three shifts daily seven days a week. Copper concentrates are shipped to Asarco smelters at Hayden and El Paso, and the molybdenum concentrates are marketed by **Lewisohn Selling Corporation,** New York, New York. All mining and stripping work is contracted to the **Isbell Construction Company** which employs 140 men on the project. In addition to mining and trucking 11,500 tons of ore daily, about 23,000 tons of rock are removed from the mine and from stripping operations, and transported to the waste dumps. Three electric shovels of 5 cubic yard capacity and 1 electric shovel of 8 cubic yard capacity are used for excavating the ore and rock. Duval employes number approximately 210 working under the supervision of George E. Atwood, resident manager; Ben G. Messer, administrative assistant; C. H. Curtis, assistant resident manager; and I. B. Phillips, mill superintendent.

CALIFORNIA

Natomas Company, gold dredging in the Folsom district of California, has only one dredge now in operation, having shut down two during the last year. During 1959 the company dredged 7,894,592 cubic yards, a 39.5 percent decrease from 1958. Gross returns per yard were 10.19¢ and total costs per yard 9.56¢, netting a return of .63¢ per yard. Comparable figures for 1958 were 9.15¢; 8.73¢; and 0.42¢ per yard.

Molybdenum Corporation of America, mining rare earth minerals near Mountain Pass, California, has completed its research program on the separation of individual rare earth metals from its Mountain Pass concentrates. An efficient separation method has been evolved to produce individual metals and products at a cost much lower than previously thought obtainable. The company is considering a pilot plant operation to make experimental quantities available for market development. Operations at the Mountain Pass property are continuing at about one-third capacity. Performance during last year, both from standpoint of mill recovery and costs, was the best since operations began.

A new evaporation plant costing about $7,000,000 will be built this year by **American Potash & Chemical Corporation** to replace two of the three units of the present system at its Trona, California plant. Production of primary products at Trona, which include borax, potash, salt cake, soda ash and lithium carbonate, totalled 769,486 tons in 1959, compared with 714,653 tons in 1958. The firm's new coarse agricultural potash plant has been successfully operating for about a year. The company's evaporation system produces potash, borax, salt cake and soda ash as primary co-products from brine from the upper deposit of Searles Lake. A separate plant, which carbonates brine from the lower deposit, manufactures additional borax and soda ash. Another facility permits production of more salt cake through spraying lake brine. These auxiliary plants have capacities to produce 25 percent of the borax, 20 percent of the salt cake and 40 percent of the soda ash for the firm, which currently is making plans to produce additional borax in 1961 by means separate from any present processes. At its Los Angeles, California, operation, the company has completed its organo-silanes plant and delivered experimental thermally-stable functional fluids to the U.S. Air Force. Production of n-butyllithium, used in the processing of isoprene to form synthetic natural rubber, has also begun there.

Even moving a blade-full of shot-rock around the curve, there's no hesitation, no sluing to spill the load. The TD-25's operator has separate speed control of each track to get full-capacity performance, full time. And only the new TD-25 has the power plus of the direct-start, turbocharged DT-817 International engine—that delivers 230 high-torque hp!

HOW POWER-STEERED, POWER-SHIFTED . . . TD-25 takes

—on California mining operation

Even before all the blast dust has settled, this International TD-25 is slamming tons of shot-rock from the benches, so trucks can resume hauling to the processing plant. Then, at this gypsum mine in California, the "25" takes over the "shovel-feeding" chore—dozing full blades of rock upgrade, downgrade, and 'round the curves, to help keep the big dippers swinging full. And in between times, the "25" takes over its third tough project: benching new haul road around mountain slopes!

Three slam-bang rock operations to handle—it's a made-to-order situation for the Planet Power-steered TD-25!

"Dead-track drag" eliminated! You don't brake a track and "half-kill" your pull-power to turn, as you do with king-sized clutch-steered crawlers. With Planet Power-steering you simply change the speed of one TD-25 track—on-the-go, and with 2-finger ease! Around comes the fully-loaded TD-25—with "live" power on both tracks and both tracks pulling. Load-limiting "dead-track drag" is eliminated!

And combined, on-the-go Hi-Lo power-shifting lets you match power to load, instantly—forward or reverse. Just shift one track to high range—the other to low—to do slope-hugging, full-bite benching, or to operate straight ahead with off-center loads!

The "25" is platformed on new 7-roller tracks with double-box-beam frames. The design provides super undercarriage strength for slam-bang conditions—strength to match the full effort of the direct-start, high-torque DT-817 International Diesel engine.

Power-steer and power-shift the TD-25 with king-sized loads. Measure the bonus capacity you get with exclusive Planet Power-steering and Hi-Lo power-shifting. See how this control combination enables you to outearn other big rigs up to 50%. Then measure what it means to get this double-barreled advantage *only* in the TD-25—and as standard equipment *to boot!* Let your International Construction Equipment Distributor demonstrate.

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International® *Construction Equipment*

"Boulder-dozing" after blasting— The TD-25 does some "blasting" itself to move "big-as-a-house" hunks of rock aside. Heavy-duty TD-25 Dura-Rollers defy the rock-dozing "grind"—with the industry's thickest shells to prevent flexing—positive grit exclusion—and 1,000-hr.-interval lube capacity!

Here's your 76-page cost and production estimating book—newest, most authentic and complete guide for estimating material-moving costs—and for selecting equipment combinations for top profits, *anywhere!* Yours for the asking from your International Construction Equipment Distributor!

over three slam-bang rock jobs

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Salt Lake City, Utah
Please establish contact prior to shipment

Kaiser Steel Company is continuing to add equipment for beneficiation of iron ore at its Eagle Mountain, California, mine. Equipment now in use upgrades iron content to nearly 60 percent before shipment to the company's Fontana steel mill. Lime rock from Kaiser's Cushenberry, California, limestone deposits is now the major source for use in the steel refining process at the Fontana open health furnaces. Cushenberry, which is 75 miles east of the Fontana plant in Southern California, also supplies all limestone for use in the blast furnaces.

NEVADA

Electro-Nuclear Metals Company is building a $2,000,000 plant for processing zirconium and hafnium ore on a site six miles north of Caliente, Nevada. Scheduled for completion in August, the plant will be built by **Electronic Metals and Equipment Company** for lease to Electro-Nuclear. Ore from the plant will come from a sizeable deposit near Escalante, Utah. According to John Piches, president of Electro-Nuclear, the new plant will employ 50 men initially with an additional 100 to be hired within six months.

Columbia Iron Mining Company, which has taken a two-year option on Nevada iron properties of **Mineral Materials Company** (see Mining World, May 1960, page 29) has been negotiating for some time with Southern Pacific Company in regard to some of that company's holdings in the same area. It is also dealing with other owners, whose smaller holdings may total more than one producing mine, if the iron content proves to be sufficiently high. (See Mining World, March 1960, page 29.) Columbia Iron Mining is a subsidiary of **United States Steel Corporation,** which recently leased property in San Bernardino County, California, from **Southern Pacific Land Company.**

Hecla Mining Company will join with four other firms in the new deep exploration program to be undertaken at the Eureka, Nevada property of **Eureka Corporation Ltd.** Other participants in the $1,000,000 project are **Richmond-Eureka Mining Company, Cyprus Mines Corporation** and **Newmont Mining Corporation,** which will manage the drilling program in the Fad shaft area. (See Mining World, May 1960, p. 29

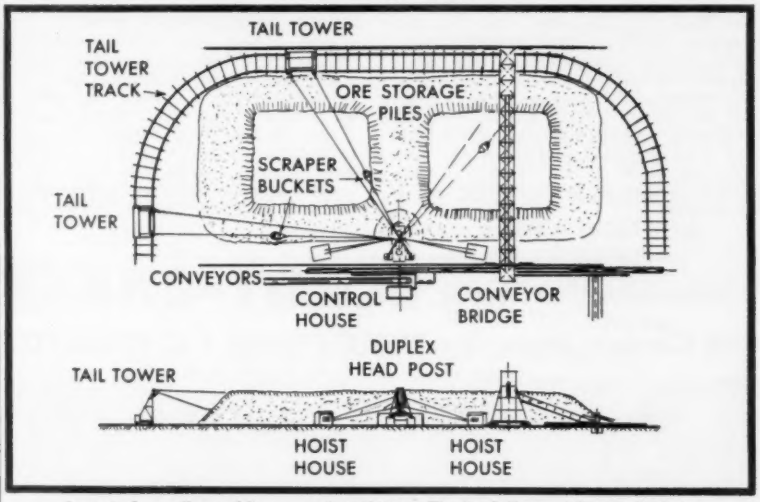
The 1,200-foot level has been reached at the **White Caps Gold Mining Company** mine near Manhattan, Nevada, and a core drilling program will be started to explore a known ore body between the 1,200 and 1,300-foot levels.

Clyde Johnson of Coaldale has a long-term lease on the Sonee group of 10 patented mining claims located at the head of Indian Creek in the White Mountains of Nevada at an elevation of about 9,000 feet. Development of the property, which has its main values in silver and lead, consists of an 80-foot shaft sunk on the vein. The **White Mountain Mining Company** operated the property in 1917.

Reclaiming Ore By Remote Control

SAUERMAN DRAGSCRAPERS HAUL 2300 TONS PER HOUR

One of two DragScraper Machines reclaiming from storage piles of an African mining company.



Layout of ore piles and Sauerman installations. The 6-yd. Crescent Scraper Buckets operate between two movable tail towers and a duplex head post.

At this African installation, two 6-yd. DragScraper Machines reclaim ore at 2300 tph. on average hauls of 125 ft. They feed a common hopper which supplies a belt conveyor system used to load the ore onto ships. The Scrapers can be worked from the same pile or shifted to opposite ends of the 100,000-ton storage area by means of two tail towers which travel the perimeter. Both buckets and tail towers are remotely controlled.

Ore from the mine is conveyed to a traveling bridge where a tripper line conveyor places the ore on the stockpiles. Although the ore becomes sunbaked and forms crusts up to five feet thick, the Scraper Buckets operate without difficulty.

DragScraper Machines are economical handlers of bulk material for both indoor and outdoor installations. Sizes from ⅛ to 15 yds. match your requirements. Write or call for our recommendations and further information.

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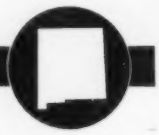
Crescent DragScrapers • Slackline and Tautline Cableways • Durolite Blocks

Tonnage of magnesium products shipped by **Basic Incorporated**, Nevada Mines Division, in 1959 exceeded that of any previous year. The Gabbs, Nye County, firm mined about 300,000 tons of magnesite ore during the year and completed a 500-ton-per-day flotation mill that produces a concentrate for dead-burning. A two-part expansion program begun late in 1959 will increase by 50 percent the Gabbs plant's capacity for producing dead-burned magnesite, and provide facilities for manufacturing a broader line of refractories. When construction is completed during this summer, Basic will be able to supply a full line of special refractories to steel-making centers throughout the world.

Work at the Silver Peak, Nevada mill of **United States Milling and Minerals Corporation** has been resumed on a three-shift basis, with employment of 67 men in the entire operation. Work at the **Ohio** mine near Goldpoint is presently centered on sinking from the 800 to the 900 level to get under a known body of ore. Regular shipments of ore are being trucked from the mine to the mill. At the **Tonopah King** mine, which is also shipping regularly, most mining is confined to the 550-foot level, with some exploration under way on other levels. Operations at the **Mohawk** mine are being pushed on drifting around the area that caved in last November on the 200-foot level and sinking of an incline shaft from the 300 to 400-foot level. A drift of about 175 feet was needed to bypass the caved area.

NEW MEXICO



Gordon & Marshall of Grants, New Mexico, are building a small gold mill just east of Magdalena at a new gold mine. They plan to do custom milling also.

An increased rate of production was attained last year by **National Potash Company** from its mining and ore-processing facilities, near Carlsbad, New Mexico which began operation in 1957. The company contracted for purchase of high grade ore which is being blended with ore from its deposit. **Freeport Sulphur Company** and **Consolidated Coal Company** share equally a 95 percent interest in the company.

Kennecott Copper Corporation has begun installing a $2,000,000 skip haulage system at its **Chino Mines Division**, to raise ore and waste at its open pit copper mines near Santa Rita, New Mexico. Aimed toward operation by May, 1961, the two-car "inclined railroad" will remove 18,000 tons of material daily up an incline of about 30°. The pit is now about 600 feet deep. Similar to that installed by Kennecott at its McGill, Nevada, open-pit copper mine last year, the hoist will eliminate almost nine miles of railroad hauling. The company plans during 1960 to mine about 22,500 tons of ore daily while disposing of twice as much waste. Stripping waste off the top of the **Niagara** ore body should be completed within a few months, when stripping of waste will begin in the **Lee Hill** area. The Lee Hill body has three distinct ore zones and copper occurs in three different types of rock, which will require different handling at the mill. Expansion of precipitation plant facilities; improved equipment, such as replacing all churn drills by rotary drills, and new methods are other expansion phases scheduled during this year.

Duval Sulphur & Potash Company is readying another ore body, held under lease from the Federal government, for production (See map, MINING WORLD, March 1960, page 25). Located about 14 miles from Duval's present Carlsbad, New Mexico, potash plant, the new deposit is expected to start producing early next year. Shaft sinking and surface construction are well under way. Ore from this deposit will go by rail to the present plant site, in continuous operation since 1952, to be mixed and milled with other ore. Increased mechanization and improved operating practices in the mine and on the surface decreased production costs during 1959. Duval is expanding its research laboratories at Carlsbad in order to broaden fields of investigation to include additional nonmetallic minerals and accelerate studies in the heavy chemical area.

Advisability of attempting to start production at this time is under study by **Sunshine Mining Company** in regard to a group of lead-barite-fluorspar claims southeast of Socorro, New Mexico. After preliminary mapping, sampling and drilling in 1958, the company undertook underground exploration and development on the property last year, completing 1203.8 feet of drifting and crosscutting, and 126.5 feet of raising. Although initial work was encouraging, fill-in work since last January, amounting to 448 feet of drifting and cross-cutting, has raised questions as to probable tonnage and grade.

Uranium sales for **Calumet & Hecla Inc.** last year were between $5,000,000 and $6,000,000 and are expected to be about the same in 1960, according to officials of the Calumet, Michigan, firm which operates the **Marquez** mine at Ambrosia Lake, New Mexico. The company is doing only what exploration is required to hold present leases and has no plans to increase production.

Production continues to increase at the uranium mines of **Kermac Nuclear Fuels Corporation.** The company's uranium mill near Grants, New Mexico, should reach rated capacity, 3600 tons per day, this summer.

Production of uranium at the Ambrosia Lake, New Mexico, operations of **Pacific Uranium Mines, Inc.** is about 600 tons daily and expected to increase soon. The **Section 24** mine, which started in November, is now producing over 450 tons daily and 1,000 tons a day is expected in a few months. Pacific Uranuim is based in Los Angeles, California, with offices in New York. It is part owner of **Kermac Nuclear Fuels Corporation.**

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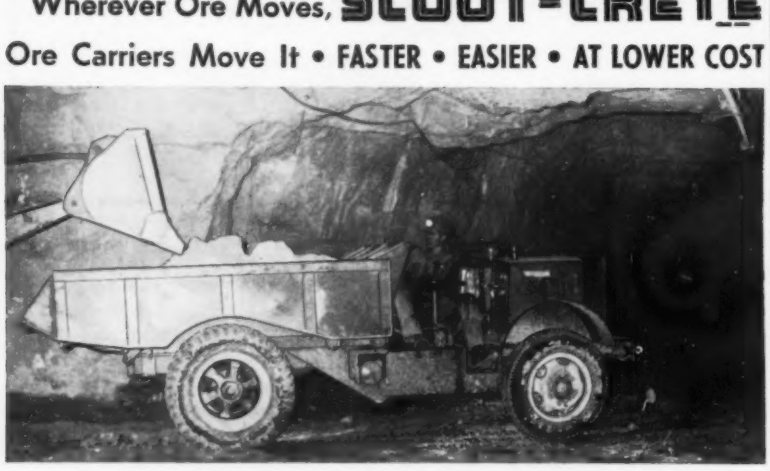

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COLORADO

Inter-American Minerals Corporation has recently been formed to develop gold, silver, platinum and rare earth claims in Colorado and Wyoming. The properties being explored are part of the corporation's $1,000,000 assets. One group of leases being worked for silver and platinum is near Leadville, Colorado; one for rare earths is in the mountains west of Fort Collins, Colorado; and another for gold and other minerals is west of Laramie, Wyoming. According to Paul A. Hentzell of the company, the group is presently trying to prove up ore claims and is doing its own assaying at a Denver laboratory.

A strong demand for molybdenum both in the United States and abroad may influence **American Metal Climax Company** to fabricate metallic molybdenum bars and sheets as well as ingots. The company operates a molybdenum mine at Climax, Colorado, through a division, **Climax Molybdenum Company.**

An iron ore open-pit mining project will be started this summer in the Aspen district at 11,000 foot elevation on Castle Creek. Operator will be the newly-incorporated **Pitkin Iron Corporation.** Plans call for trucking the ore to a Rio Grande rail siding on Woody Creek about four miles west of Aspen, where it will be stockpiled for shipment. L. S. Wood of Chicago, Illinois; J. A. Harker of Boise, Idaho; and Robert Delaney, Glenwood Springs, Colorado, attorney, are incorporators of the firm.

Three sites are under consideration for the proposed $6,704,000 manganese refinery to be built to treat rhodonite concentrate from **Standard Uranium Corporation's** Sunnyside mine at Silverton, Colorado. The tentative sites are Castle Gate, Utah, Grand Junction and Durango, Colorado. The latter is favored, but the pending sale of the narrow gauge line of the Denver & Rio Grande Western Railroad to a charitable foundation for use as a tourist attraction, would end freight movements by rail from Silverton to Durango. Actual choice of location for the electro-chemical reduction of rhodonite also depends on which of two processes will be used by the eastern firm that will build the facility. **Standard Uranium** is now reopening the **Sunnyside** mine through the **Gold King** tunnel. The Sunnyside area has millions of tons of rhodonite ore available for mining.

UTAH

A program which would be the first known, commercial effort in the United States to extract vanadium from the hundreds of millions of tons of phosphatic ores in the Phosphoria formation of Utah, Idaho, Wyoming and Montana, has been initiated by **Minerals Engineering Company** of Grand Junction, Colorado. The company will build a plant, scheduled to be in full production this summer, that will utilize an intermediate product from elemental phosphorous furnaces of **Food Machinery & Chemical Corporation's** mineral products division at Pocatello, Idaho. The vanadium pentoxide produced will run more than 10 percent vanadium, as against vanadium mined on the Colorado plateau, which now has an average value of about 1.25 percent. It is estimated that there are about 3,000,000 pounds of vanadium available from all elemental production in the Inter-mountain region. Minerals Engineering will build the new plant, capable of producing 2,000,000 pounds annually, adjacent to its tungsten facilities in Salt Lake City, Utah.

Lead-zinc-silver discoveries of **Bear Creek Mining Company** in Utah's Tintic district were described as "a mighty big show of mineralization" by Douglas Cook and John B. Bush of the company in a recent discussion before the Utah Mineralogical Society. Bear Creek, exploration subsidiary of **Kennecott Copper Corporation,** has had two diamond core drills operating underground to further exploration, as well as one cross-cut. The company continues to encounter mineralization in some holes.

A small uranium ore body adjacent to its **Rattlesnake** mine in northern San Juan County, Utah, is under development by **Continental Materials Corporation,** headquartered in Grand Junction, Colorado. Mining on an underground basis is being continued at the Rattlesnake. Continental is also said to have undertaken development of a gold prospect in the Midas mining district north of Winnemucca, Nevada.

Approximately 20,797 tons of uranium ore with a gross value of $411,870 were extracted last year from uranium properties operated by **White Canyon Mining Company** in San Juan County, Utah. White Canyon was sold last December to **Yuba Development Corporation,** subsidiary of **Yuba Consolidated Industries.** Uranium ore reserves at the White Canyon properties are believed sufficient for at least three years' profitable operation. Exploration is planned in the area to develop additional reserves.

WYOMING

Another major expansion of soda ash output in Green River, Wyoming, is planned by the **Chlor-Alkali Division** of **Food Machinery and Chemical Corporation.** The division will expand its production by 200,000 tons yearly, bringing total annual capacity to 750,000 tons per year. First phase of the expansion will be completed early next year, and the second by early 1962. The project will include new equipment for underground mining of trona ore and improvement of processing at the soda ash refinery. Mining presently includes use of a specially designed auger for use in extracting trona, a deposit harder to cut than coal. A unique feature of the refining process used is the needle-like shape of the soda ash crystals produced. Because of this shape, the soda ash flows freely, dusts less and has generally better performance.

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The Minerva Company is resuming fluorspar mining operations at the Jefferson Mine, west of Humm's Wye, near Elizabethtown, Illinois. The mine was shut down and underground equipment removed last September.

A heavy media ore processing plant that will handle ore from small mines in the area may be moved to West Plains, Missouri, if the **Plateau Mining Company** can find a suitable site for the big plant. Now located at Koshkonong, 17 miles southeast of West Plains, the plant is near a mine that produced some 750,000 tons of ore before the deposit was exhausted. If the plant is moved, it will provide a central location for operators who may sell their ore to the Plateau company or have it processed for private sale.

A ground survey on about 2,000 acres of land in Douglas County, Missouri, is being undertaken by **The Taylor Oil and Minerals Corporation** of Chicago, Illinois, which holds mineral leases on land where aerial surveys were made previously. The company is chiefly interested in deep iron ore deposits. Fringe operations earlier in Howell and Green counties showed an iron ore suitable for blast furnace reduction with but little upgrading, according to S. C. Gray of the Taylor firm.

Missouri Pacific Lines has begun laying track for its 26-mile line to the **Pea Ridge** iron mines in Washington County, Missouri, that will connect the St. Louis-Poplar Bluff main line at Cadet to the $40,000,000 Pea Ridge project of **Meramec Mining Company.** About midway between Cadet and Pea Ridge, a spur will drop south for about two miles to serve the $6,000,000 **Indian Creek** works of **St. Joseph Lead Company.** Advance estimates are that up to 10,000 tons of ore will be handled daily at Pea Ridge eventually, with rail movement of up to 100 cars daily.

Eight drilling rigs are in operation near Bunker, Missouri exploring for lead. **Bear Creek Mining Company,** subsidiary of **Kennecott Copper Corporation,** is reported to be paying cost of drilling in the area, which is on the Dent-Reynolds County line northeast of Eminence.

The Central Transformer Corporation of Pine Bluff, Arkansas has sold its **See-Tee Mining Corporation,** operating in New Mexico and Arizona, to private investors in Albuquerque, New Mexico.

Granite City Steel Company and **American Zinc, Lead and Smelting Company,** in a joint venture, completed seven deep diamond drill holes at the Boss-Bixby and Bourbon iron prospects in Missouri. At Boss-Bixby, a commercial thickness of both iron and copper are indicated. At Bourbon, only iron ore has been found. Mineralized areas thus far have been between depths of 1,700 and 3,500 feet.

New Jersey Zinc Company is reported to be completing the fill-in drilling on two more zinc mines in the Copper Ridge zinc district of East Tennessee. New Jersey already operates the **Treadway** mine, which produces 1,000 tons per day in the same area.

A program to redefine lithium ore reserves at Kings Mountain, North Carolina, by **Foote Mineral Company** indicates a total of 20,746,297 tons averaging 1.53 percent Li_2O, a reserve 55 percent higher than any previously reported estimate. Although not yet fully proven, an additional reserve of 15,769,075 tons is indicated in adjacent ground. With the exception of lithium recovered as a minor byproduct from salt brines, the company believes that its lithium ore has greater economic value than any other presently known source.

The **Kenshaw Mining Company** is reopening the old **Lamar** gold mine in Kenshaw County, South Carolina, which has been closed since the early 1880's.

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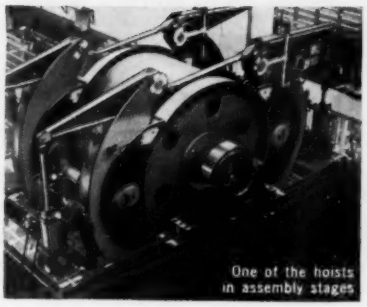
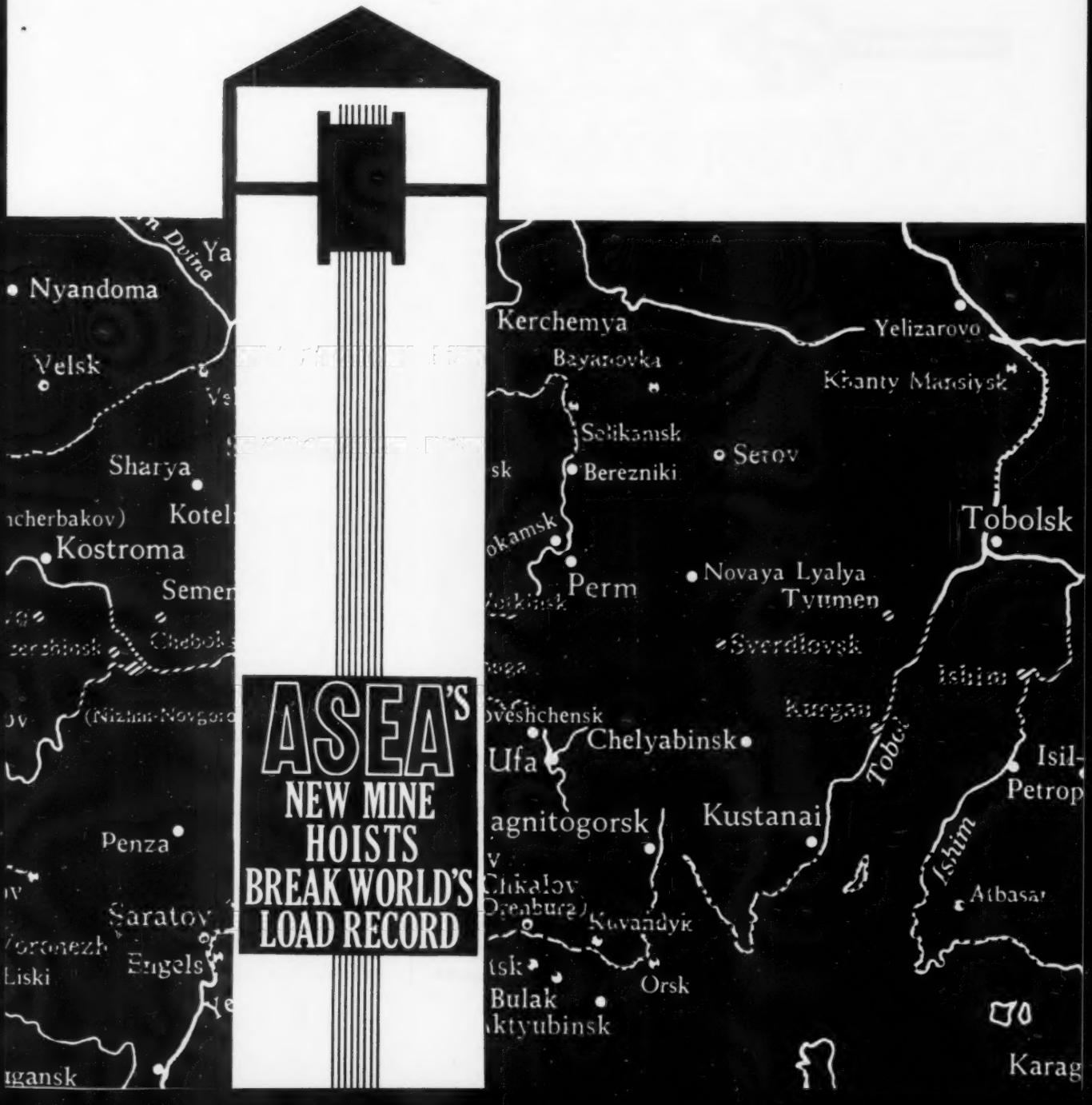
Skip weight	44 tons	Diameter of Pulley	12'2"
Depth of shaft	3940 ft.	Length of Pulley	7'2"
		Motor output	12,000 h.p.


One of the hoists in assembly stages



Samples drawn from the vein run as high as $70 per ton, and from the mill tailings, over $17.00 per ton, according to Marshall Haney, mining engineer.

A $1,000,000 plant for producing di-ammonium phosphate will be built by **Virginia-Carolina Chemical Corporation** adjacent to its superphosphate plant at Nichols in Polk County, Florida. The plant will have a capacity of 100,000 tons of di-ammonium phosphate per year and is scheduled to be in operation this fall. A $10,000,000 expansion of the company's superphosphate plant is scheduled for completion in June, and another project, construction of a new phosphate plant at Clear Springs, south of Bartow, is under way.

IRON RANGES

A sizeable development project at its **Hill Annex** iron mine at Calumet, Minnesota, has been started by the **Minnesota Ore Division, Jones & Laughlin Steel Corporation.** Involved in the program is stripping the south extension to the present deep open-pit. The property contains one complete section of land, 640 acres, with the stripped area totalling about 245 acres. In addition, the company owns or leases some 1,300 acres from dump sites and tailing disposal ponds. Since 1917, ore has been shipped from Hill Annex every year except in 1932. Four other iron mines of the division are shipping iron ore on the Mesabi range—the **Lind-Greenway**, near Grand Rapids; the **Longyear** mine at Hibbing; the **Columbia** mine at Virginia, and the **Schley** mine at Gilbert.

In Hibbing, Minnesota officials of **Western-Knapp Engineering Company** were hosts at an open house recently that marked the opening of the firm's new office building at 2727 Thirteenth Avenue, East. The firm of design, engineering and construction specialists has headquarters in San Francisco, California. Manager of the operation in Hibbing, where Western-Knapp has been active for 12 years, is Bengt A. Samuelson.

A reject screening plant has been completed at the **Sunday Lake** mine operated by **Pickands Mather & Company** near Wakefield, Michigan. The plant rejects all iron ore rock more than four inches in size, and the surplus rock is then hauled to a storage area for possible processing in the future. According to R. D. Hodge, mine superintendent, the 1960 shipping season may open earlier than usual and equipment is being repaired in preparation for possible starting early this month.

Operations at the Babbitt and Silver Bay, Minnesota, mining operations of **Reserve Mining Company** are proceeding at capacity. When the contemplated expansion program to increase capacity to 9,000,000 tons of pellets annually is completed in about two years, Reserve Mining Company will have the largest open-pit mining operation in the world.

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ALASKA

Devonian reef-breccia is the unusual host rock for copper mineralization found so far by **Bear Creek Mining Company** in the Ruby Creek area, Ambler River Quadrangle in Alaska. The mineralization occurs as low-temperature chalcopyrite-bornite-marcasite. No evidence of intrusives or pyrometasomatic alteration has been observed and hydrothermal alteration, if present, is negligible. Preliminary economic appraisal indicates that capital and operating cost differentials in the Arctic location will place break-even ore grade at more than one and one-half times that required in western United States. Cost of boarding the crew during the recent exploration was $4.60 per man per day, including cook, fuel, and air freight from Fairbanks. Drilling has been accomplished thus far at about $7.00 per foot. The copper showings were discovered by gold seekers many years ago and abandoned. Work of Bear Creek, exploration subsidiary of **Kennecott Copper Corporation,** since 1957 has consisted of geological, geophysical, and geochemical surveys and 27,000 feet of diamond drilling. Russell H. W. Chadwick, geologist with Bear Creek's Northwest district office in Spokane, Washington has been in charge of most of the work.

Drilling by an independent contractor is being undertaken on the Union Bay magnetite deposit of **Columbia Iron Mining Company.** Small sack type drills are used and a 96 percent core recovery has been obtained to depths of 100 feet.

IDAHO

Three projects designed to open unknown ore in the Sun Con area of the Coeur d'Alene district Silver Belt, Shoshone County, Idaho are being undertaken by **Sunshine Mining Company,** the nation's largest silver producer. The property, owned by **Sunshine Consolidated, Inc.,** has been developed under a profit-sharing agreement from deep workings of the **Sunshine** mine. The new work includes westerly drifting on the 3,400 and 3,700-foot levels and diamond drilling south of the Yankee Girl vein on the 3,100-foot level. The drills will search for the downward continuation of silver-bearing structures discovered and mapped from surface work done several years ago. Sun Con production in 1959 was 9,404 tons of ore containing 258,859 ounces of silver. W. M. Yeaman, Yakima, Washington, is president of Sunshine Consolidated, and R. M. Hardy, Spokane, of Sunshine Mining.

Day Mines, Inc., Wallace, Idaho has set up a new exploration department to conduct an intensive search for new mining properties. Indicated ore reserves in the firm's **Dayrock, Hercules, Monitor,** and **Tamarack** mines were estimated to total 186,506 tons early this year. The Hercules is being closed and reserves

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at the firm's Sunset Lease have reached the vanishing point at current prices for zinc and lead. Lessees produced 16,468 tons of zinc-lead-silver ore at the **Mountain Goat** and **Silver Tip** mines in the Sunset Peak area north of Wallace last year and **Sherman** mine lessees shipped one lot of crude silver-lead ore. Development of the Hornet vein, exposed in the Dayrock mine on Christmas Eve, has opened ore for a length of 205 feet and average width of 8 feet at last report. The ore averaged about 10 percent lead and 10 ounces of silver to the ton.

Diamond drilling of the **American Silver Mining Company-Silver Standard Mining Company** area of the silver belt between Wallace and Kellogg, Shoshone County, Idaho, was resumed recently by **Hecla Mining Company** from its **Silver Summit** Mine East Exploration Lateral. H. E. Harper is Hecla's chief geologist.

Idaho's largest zinc mine, the **Star,** at Burke, Shoshone County, yielded 218,239 tons of ore in 1959. Millheads were 9.95 percent zinc, 4.32 percent lead and 1.41 ounces of silver per ton. Ore reserves were increased slightly to 862,629 tons. Production recently was stepped up to 1,000 tons daily from 700. The mine is owned by the **Bunker Hill Company** and operated by **Hecla Mining Company** on a free basis.

MONTANA

Chromite ore reserves at the Nye, Montana, operations of **American Chrome Company** continue to rank as the most important and economically available in North America. The firm's ferrochrome reduction plant produced 2,100 tons of metal in 1959 and delivered more than 105,000 tons of concentrate to the government chromite stockpile. American Chrome is 87½ percent-owned by **Goldfield Consolidated Mines Company** of Reno, Nevada. John Bley, manager, has announced that the firm will switch to ferrochrome production at the end of this year. Ferrochrome will be marketed commercially. There is estimated to be enough ore reserves at the **Mouat** mine to produce 5,000,000 tons of ferrochrome.

The Anaconda Company has started vein stoping operations at the **Badger** mine zinc veins. This work is in addition to the Black Rock-Elm Orlu low-grade zinc ore caving project. This work plus other underground work has created a shortage of underground miners in the Butte area. Production at the Butte, Montana mines of **Anaconda** in 1959 declined more than 30,000,000 pounds to approximately 140,000,000 pounds because of a labor strike which limited operations to less than eight months. Bulk of copper production was from open-pit and blockcaving operations. Vein mining was limited to the **Mountain Con** mine. The **Alice** open-pit mine yielded more than 279,000 tons of zinc ore in less than five months of operation.

Rocky Mountain Phosphates Inc. is now producing defluorinated phosphate for animal feeds in the old domestic manganese plant in Butte, Montana. Ore for this material is obtained from the **Anaconda Company** Idaho phosphate mines, and the necessary chemicals are obtained from the smelter in Anaconda.

At the **Nancy Lee** mine, Mineral County, Montana, drifting is under way on an ore zone intersected recently in a 350-foot crosscut from the shaft on the new 200-foot level. At the point of intersection, the vein was reported as being 16 feet wide and assays of muckpile samples showed lead, zinc, silver, and copper. The flotation plant at the mine is to be reopened soon. E. G. Smith, Osburn, Idaho, is in charge of work. Harry G. Alway, Kellogg, Idaho, is vice president of **Nancy Lee Mines, Inc.**

Late winter temperatures which sent the mercury to as low as 50° below zero put **Spokane National Mines, Inc.,** behind schedule in its Bannack area (Beaverhead County, Montana) operations. The firm is preparing the Bannack gold mine and the New Departure silver mine for production.

WASHINGTON

Knob Hill Mines, Inc., and **Day Mines, Inc.,** are carrying on a joint development project in the Republic gold camp, Ferry County, Washington. The work is being done on separately owned properties adjacent to the **Knob Hill** mine and Day Mines' **Gold Dollar** mine, which Knob Hill is mining under lease. The Gold Dollar ore body yielded 42,000 tons of high grade gold-silver ore in 1959. Work on the new bottom 11th level has opened an ore body 325 feet long and 11½ feet wide.

At the Mohawk property north of Conconully, Okanogan County, Washington **Sunny Peak Mining Company** is planning to develop a vein of copper-silver ore uncovered by bulldozing last fall. A new option has been taken on the adjoining Mineral Hill property. Cline E. Tedrow, Spokane, has been retained as consultant mining engineer. C. J. Weller, Coulee City, is company manager.

Dawn Mining Company's uranium concentrate purchase contract with the Atomic Energy Commission has been extended to December 1966 and provides for purchase of appropriate quantities of U_3O_8 in the 1962-66 period from reserves developed before November 24, 1958. The first AEC contract with Dawn was signed in August, 1956, and the mill delivered the first uranium concentrate in September, 1957. Dawn's 400-ton-per-day processing mill is near Ford in Steven's County, Washington. Commercial deposits of uranium were first discovered in this area in 1954.

Copper Project Using New Segregation Process Gets Under Way

Lakeshore open-pit mine is supplying 500 tons a day of chrysocolla ore with magnetite to adjacent mill of Transarizona Resources, Inc., 28 miles south of Casa Grande, Arizona. (See MINING WORLD, December, page 19) Diamond and rotary drilling have outlined an ore body 5 to 30 feet below the surface, and reserves are said to be sufficient for seven to eight years. Water for mining and milling is pumped two miles from a deep well in the Santa Rosa Valley. Power is purchased from the Trico Electric Company and is brought in over a 14-mile 3-phase transmission line.

Construction on mill nears completion in picture taken in April. Operations began the end of May and are expected to reach 1,000 tons a day by early 1961. Mill uses salt coke segregation process to produce a fine flake copper by low temperature furnacing. Cooled calcines are then ground in a ball mill and copper recovered by conventional flotation methods. Byproduct magnetite will be recovered by means of wet magnetic separation. Picture shows primary, secondary, and tertiary crushing units at left, first of four rotary calciners in center, and flotation units at far end.

MEN who make the news in the U. S. A.

C. L. EISENHART

F. A. O'NEALL

A. A. WALLACH

ANDREW SIMS

E. O. BONNER

Charles L. Eisenhart has been promoted to triple superphosphate manager at American Cyanamid Company's Brewster, Florida plant. He joined American Cyanamid Company in 1958 and served as chemical engineer and senior chemical engineer before moving into the triple department, where he became assistant triple superphosphate manager in October 1959. In his new position, Mr. Eisenhart succeeds **F. A. O'Neall** who has been named assistant chief engineer. Mr. O'Neall's transfer will give the engineering department the benefit of his many years' chemical plant development and operating experience. He has been with Cyanamid since 1949.

Lee L. Travis, former vice president of the Banner Mining Company, Tucson, Arizona, has been elected president of the firm. In this position, he will succeed **Ernest S. Bowman,** who has resigned because of ill health.

Wallace G. Woolf, vice president in charge of the Kellogg, Idaho operations of the Bunker Hill Company, has retired after 42 years' service. He will continue with the firm in an advisory capacity. Mr. Woolf devised a commercial treatment for zinc-lead ores of Idaho's Coeur d'Alene Mining Region which resulted in construction of the company's electrolytic zinc plant.

Ellott F. Dressner, exploration geologist for the International Minerals & Chemicals Corporation, Skokie, Illinois, since 1956, has joined the Lone Star Steel Company, Lone Star, Texas, as chief ore engineer.

Rush Muse, who for the past three years has been serving in New York as office engineer for Kennecott Copper Corporation, returns to the Nevada Mines Division to take over as pit superintendent, a position which **Frank Quilici** recently resigned for health reasons.

A. H. Neal has been named general superintendent of Inspiration Consolidated Copper Company, Inspiration, Arizona. Since 1945, Neal has been mechanical engineer for the company. Succeeding him in that position is **Howard M. Propper,** who has been with the company as chief draftsman since 1947 and assistant mechanical engineer since 1952.

W. L. Kendrick, formerly of Boulder City, Nevada, has been named vice president and general manager of Tungsten Mining Corporation, Henderson, North Carolina.

A. A. Wallach, mineral industries development engineer for Kaiser Engineers, has been reassigned to the headquarters' office in Oakland, California. Mr. Wallach's new assignment will be to work as development engineer throughout the United States and Canada for engineering and construction services provided by the company in connection with mining and quarrying, rock products, ore processing and nonferrous metals production.

Meredith E. Smith has joined International Minerals & Chemical Corporation as senior operations research engineer, assigned to the industrial engineering department. Mr. Smith comes to Carlsbad, New Mexico from Wilmington, Delaware where he has been associated with E. I. du Pont de Nemours as a consultant in operations research.

Robert D. MacDonald, former assistant chief of mineral processing division of Battelle Memorial Institute, Columbus, Ohio, has been named vice president of Bonneville, Ltd. at Salt Lake City, Utah. Mr. MacDonald is a Montana School of Mines graduate, and holds an M. A. degree in metallurgy from Massachusetts Institute of Technology.

Glenn E. Allen has been appointed superintendent of the Boulder, Colorado mines of Allied Chemical Company's General Chemical Division. Most recently acting superintendent, Mr. Allen has served with General Chemical for 13 years, also holding the posts of shift boss and mining engineer.

Marshall Haney, consulting mining engineer of Teppahannock, Virginia, recently completed a preliminary examination of the Lamar Gold Mine in Kenshaw County, South Carolina for the Kenshaw Mining Company.

Robert W. Kliebenstein has been appointed manager of Calumet & Hecla, Incorporated's Marquez uranium mine north of Grants, New Mexico. Mr. Kliebenstein has long been familiar with the Grants area, having participated in the original geological surveys which helped to establish the Marquez mine.

Henry J. Long has been appointed general manager of the Mineral Industrial Commodities of America mine and milling facilities at Cordova, New Mexico. Mr. Long will supervise operations of the 300 ton-per-day capacity Clute mill recently completed at the mine site, and of the fine grinding plant located near Pojaque, New Mexico.

Andrew R. Sims has retired as general superintendent of the Butte, Montana mines of the Anaconda Company. Mr. Sims first worked in the Butte Mines in 1915 during vacation from Oregon State College; he became assistant foreman in 1925 and later foreman of the West Colusa, Stewart and Tramway Mines. In 1946, he was named planning engineer for the Kelley Mine; he was promoted to assistant general superintendent of mines in 1950, and to general superintendent of mines in 1952. He will be succeeded by **Edward O. Bonner.** Mr. Bonner has been an assistant general superintendent since 1952, prior to which he was in charge of the Berkeley and Alice pits, Badger and High Ore Mines and the Black Rock-Elm Orlu low grade zinc project.

Charles C. Nolan has been named western district manager for Hardinge Company, Incorporated, with headquarters in San Francisco, California. He succeeds **R. L. Baldwin,** who will act in a consultant capacity at the firm's San Francisco headquarters at 24 California St. Mr. Nolan joined the Hardinge staff as a sales engineer and has been assistant to the western district manager since 1956.

Recent appointments announced by the U. S. Bureau of Mines are those of **Laurence B. Berger** as chief of the new Division of Health and Accident Prevention, and **Donald S. Kingery** as head of the Health and Safety Research and Testing Center in Pittsburgh, Pennsylvania. Mr. Berger, will be staff adviser to **James Westfield,** assistant director for health and safety, in Washington, D.C.

John W. Phillips has joined the mining department staff of Republic Steel Corporation's Lyon Mountain, New York, operations. Mr. Phillips was formerly geologist and mine foreman for New Jersey Zinc Company in Gilman, Colorado, and Jefferson City, Tennessee.

Ed T. Hewitt has been promoted by Electric Steel Foundry Company of Portland, Oregon, to be vice president of its international division. Mr. Hewitt joined ESCO in 1938 as manager of the San Francisco, California, sales district and in 1949 transferred to New York as general manager of ESCO International and manager of the eastern sales district.

Robert G. Peets, presently general superintendent of Bethlehem Steel Corporation's Cornwall Division, has been employed as assistant resident manager of the Meramec Mining Company at Pea Ridge, Missouri. He will assume his duties with Meramec in July 1960.

Large Copper Deposit Found in Western Argentina

A low-grade copper deposit of large tonnage was reportedly discovered in early 1960 on the east slope of the Cordillera de La Brea, Department of Iglesia, Province of San Juan, in western Argentina. This promising prospect, at 14,760 feet elevation, is now being examined by a joint Argentine-North American technical commission.

Disseminated malachite, azurite, and cuprite in a brecciated felsite are found over an area of approximately 160,000 square meters, according to first reports. Glacial debris covers much of the area so this is considered a minimum figure. Since only preliminary studies have been made no figures have been given concerning estimated grade and tonnage of the prospect.

The discovery was made by a group of I.B.E.C. (International Basic Economy Corporation) geologists in collaboration with an Argentine technical group working for the Province of San Juan.

Japanese Smelters Seek New Sources of Foreign Copper

Japanese copper smelters, whose combined capacity is approaching 20,000 tons per month, are increasingly concerned with getting raw material to keep facilities operating continuously. Major companies are encouraging development of mines in other countries, rather than relying too heavily on present sources of imported copper concentrates.

Nippon Mining Company is endeavoring to increase output at the Portecero mine in Chile, which it developed, and also plans to develop a copper mine in Peru. This company has also invested in mines in the Philippines, and has begun prospecting at the Undo mine, Fuju Island, where a considerable ore reserve has been confirmed. Nippon continues to import copper from Cowichan Copper Company Ltd. of Canada, operated jointly with Sumitomo Metal Mining Company Ltd.

Sumitomo, which is not expanding its copper activities as much as other copper producers, recently was asked for financial assistance by Bethlehem Copper Corporation of Canada to develop its mine in British Columbia. For the present Sumitomo is promoting a program of offering technical assistance to foreign mines in order to obtain raw material in return.

Mitsui Mining Company is importing copper from Sipalay and Bagakai mines in the Philippines, and also has development plans in Chile. Recently top executives of the company visited Chile to determine the worth of the project there.

Copper from the Toledo mine in the Philippines is imported by Mitsubishi Mining Company. Furukawa Mining Company intends to develop the Agusan mine on Minadano Island after settlement of present disputes over mining claims ownership.

In Bolivia, Nitto Metal Mining Company formed a new company, Nitto-Bolivia Mining Company, to develop the Chaccari mines. Dowa Mining, Ito-chu and Nichimen trading companies have also invested in this project in which prospecting has been carried out. Total output from the Bolivian mine is scheduled to go to Dowa Mining.

COLUMBIA—**Compania Quimica Industrial S. A. (QUIN)** of Cali, Colombia, will build a plant for production of double and triple superphosphate on the left bank of the Magdalena River, near Puerto Berrio. Cost of the machinery for the operation will be about $3,000,000, and it will be purchased in the United States. **The Frontino Gold Mines Ltd.**, a subsidiary of the **South American Gold and Platinum Company** of New York has contracted to sell QUIN annually 40,000 tons of pyrite, a byproduct of gold mining operations in Antioquia, Colombia. This will be used to produce sulphuric acid for manufacture eventually into the superphosphate fertilizer.

PERU—An expansion project to be undertaken by **Peruvian Santa Corporation** calls for doubling steel ingot capacity of its Chimbote steel mill to 120,000 tons per year and tripling the capacity of the complementary hydroelectric power plant in the Canon del Pato to 150,000 kilowatts. The firm will also reclaim 60,000 hectares of desert land through irrigation. The expansion program is closely related to a similar project of the **Marcona Mining Company** to install beneficiation facilities at San Nicolas Bay. Marcona holds a long-term lease on iron ore claims owned by Santa Corporation on the Marcona plateau. Ore reserves available in the area may amount to 600,000,000 tons.

MEXICO—Final plans are being made for construction of a 30-ton-per-month pilot plant at Santa Rosalia, Baja, California. A joint venture of **Calumet-Hecla** and **Santa Rosalia Mining Company**, the pilot project will use sulphuric acid leaching on the tailings and dumps from the old **Boleo** copper mine.

CHILE—One of the longest belt conveyor systems in the world is being completed in Chile for **West South American Overseas Corporation.** The system, 11 kilometers long, will carry iron ore downhill from the **Carmen** mine of **Cia Minera Santa Fe**, at the rate of 1,500,000 tons yearly.

NICARAGUA – Decreased operating costs and increased reserves are reported by **La Luz Mines Ltd.** for its **Siuna** gold mine during 1959. Tonnage treated during the year, 719,100, was slightly higher, but grade was a bit lower than the previous year. Production was valued at $2,419,421 from 68,337 ounces of gold and 33,735 ounces of silver. Overall recovery averaged 90.41 percent. Reserves were increased by 412,000 during the

Sematan Bauxite Plans 300,000-Ton Shipment in 1960

Sematan Bauxite Ltd. has scheduled production of 300,000 tons of high-grade bauxite ore during 1960. This mine is located at Sematan, Lundu, Sarawak Territory, on the north coast of the island of Borneo. Pictured at left above is the washing plant with ore stockpiles in the foreground. Mr. C. Schwander, technical director, is pictured at right in front of the washing plant. The mine was started at the end of 1957 in the middle of the tropical jungle. By October 15, 1959 more than 300,000 tons of ore had been shipped; mostly to Japanese aluminum plants. Ore is mined from open pits and washed in the plant near the sea coast. Ships are loaded directly from the stock pile by means of a conveyor belt. The labor force is composed of Malayans, Chinese, and the local Dayaks. Mr. A. Mosher is mine superintendent.

year, amounting to—positive and possible —5,006,000 tons, grading 0.12 ounce of gold per ton. Shaft sinking is under way; the shaft is to be deepened by 385 feet to a total depth of 1,710 feet.

VENEZUELA—Negotiations are under way between the Venezuelan government and the **Reynolds Metals Company** of Richmond, Virginia, for construction of a bauxite reduction plant in the Guayana region, north of the Orinoco River. Tentative plans call for location close to the Caroni river hydroelectric plant and to the Orinoco for easy access of raw material from British Guiana and shipment of the product. The proposed plant would supply this country with all its aluminum needs, about 15,000 tons a year, currently imported. Extensive bauxite deposits have been found recently in the Gran Sabana area of Bolivar State, but amount and grade are still undetermined. Smaller deposits estimated at 1,800,000 tons were previously located in Bolivar and in Delta Amacura Territory, with samples from the latter assaying 35 percent Al_2O_3. Other regions may contain more promising deposits, since the terrain characteristics in some sections are similar to those in British and Dutch Guianas where some of the world's largest bauxite deposits are located. Canadian, Italian, and Japanese firms have also expressed interest in the Guayana region which also has iron ore, manganese, and laterite deposits.

MEXICO—**Tubos de Acero de Mexico S.A. (TAMSA)** is considering construction of a steel mill in Veracruz that would use ore from deposits in the Isthmus of Tehuantepec.

CHILE—Development work by **Cerro de Pasco Corporation** during the last year at its **Rio Blanco** copper property in Aconcagua and Santiago provinces has increased the ore indicated to 121,100,000 short tons, with an average grade of 1.58 percent copper. Of this tonnage, 87,000,000 short tons are considered to be proven ore reserves. Plans for bringing the mine into production are nearing completion. Their execution hinges on completing working agreements presently being negotiated with the Chilean government, as well as satisfactory financial arrangements. Options to purchase the Rio Blanco property must be exercised by next October 1.

BOLIVIA—The Mutun deposit, although not being worked at present, is considered by some authorities to be the world's largest iron ore deposit. A huge hematite deposit covering 58 square kilometers and 200 meters in depth, it reportedly contains 50,000,000,000 tons of probable ore of 54 percent Fe; 20 percent SiO_2; 0.15 percent S, and 0.13 percent P. High cost of transportation to a smelter and other difficulties have prevented development, but smelting at the site is under consideration.

NICARAGUA—**Rosita Mines Ltd.**, subsidiary of **La Luz Mines Ltd.** of Canada, estimates total reserves of 3,782,000 tons of ore, grading 3.01 percent copper, at its Rosita property which started production a year ago. During the initial production period, recovery of copper was only about 50 percent but currently it has improved to 78 to 80 percent. To make the reserves available for open pit mining some 1,264,000 tons of waste material must be removed. The company plans to install a sulphur burner at its 600-ton capacity plant since insufficient sulphides were obtained to produce sulphuric acid.

PERU—**Fermin Malaga e Hijos,** this country's leading tungsten producer, is currently treating about 200 tons per day of low grade ore to produce about 30 tons monthly of about 60 percent WO_3. However the company has recently increased its activity in copper and is producing about 60 tons of copper concentrate per month.

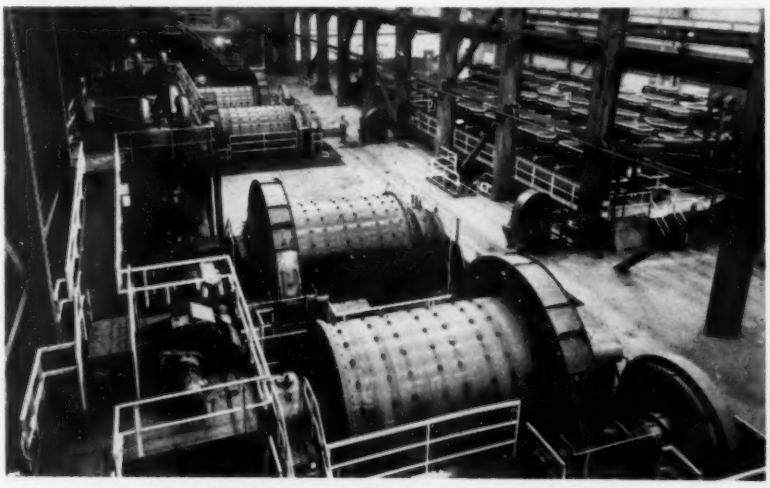
CHILE—**Andes Copper Mining Company,** subsidiary of **The Anaconda Company,** is operating its new treatment plant at El Salvador for recovery of molybdenum values in copper ore. Total copper production last year was 120,628,337 pounds, of which about 85,000,000 pounds came from **El Salvador** and the balance from the **Potrerillos** mine, which ceased operation in June. **Chile Exploration Company,** another Anaconda subsidiary, achieved a new annual record in 1959, producing 612,994,731 pounds of copper at Chuquicamata. The firm installed additional ball mills in the primary grinding circuit and more regrinding equipment to increase the capacity of the concentrator. Conversion of the electrolytic tank house for refining blister copper resulted in reaching a 5,000-ton monthly capacity, to be increased to 7,000 tons this year. A new sulphuric acid plant began operating early this year to supply additional acid needed in the electrolytic plant's oxide division. Production of molybdenum from copper concentrates on a developmental basis reached 6,000 pounds of molybdenum per day.

CHILE—**Empresa Nacional de Fundiciones** (ENAF) will invest $2,000,000 in mining activities this year. The firm will develop and increase production of copper concentrate for the smelter at Paipote and the smelter, Las Ventanas, now under construction.

JAPAN—Negotiations under way by three leading Japanese aluminum producers involves importing 10,000 tons of bauxite from Australia on a trial basis. Though the Japanese firms were not named, the three major companies that refine alumina from bauxite are **Nippon Light Metal Company, Showa Denko K.K.,** and **Sumitomo Chemical Company,** all producers of aluminum. **Western Mining Company,** which has a bauxite mine near Perth, and **Commonwealth Aluminum Corporation,** which has a mine at Cape York, are the Australian firms that may supply Japan.

TURKEY—Aerial and auto surveying methods are being used in prospecting for radioactive deposits in Turkey. About one-fifth of the total Turkish territory has been surveyed, resulting in location of some interesting anomalies which are now being evaluated.

MALAYA—Although some 15 dredges may have to close down during the next three years for want of new dredging ground, **Pahang Consolidated Company Ltd.** has prospects of continuing operations for at least 50 years. One of the few companies that mine tin by underground methods, Pahang has increased output since full-scale operations were



Automation for New International Nickel Mill

Extensive use of instrumentation in the Levack nickel mill permits centralized, and in some cases automatic, control of crushing, grinding, flotation, and dewatering. The highly automated mill located near the Levack mine was opened recently by The International Nickel Company of Canada Ltd. as part of its expansion in the Sudbury, Ontario area. Pictured above are the grinding mills, cyclones, and flotation cells. All operations are controlled from centrally located instrument panels. Many new techniques, such as the use of radioactive isotopes for making density measurements, are employed. The Levack mill, with a capacity of 6,000 tons of ore daily, is the third Inco plant in this area which, with the new mining project under development at Thompson, Manitoba, will bring the company's nickel production capacity to 385,000,000 pounds yearly by next year.

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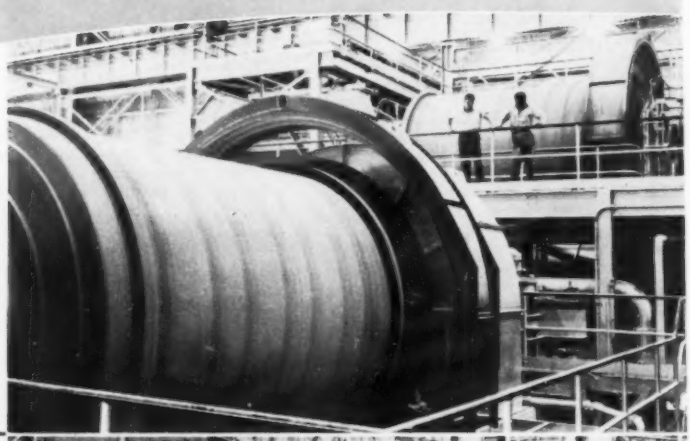

One of the eight 10′x 14′ Marcy Grate Discharge Ball Mills is shown in foreground, and one of the four 10′x 14′ Marcy Open End Rod Mills in the background.

Ball mill section consists of eight 10′x 14′ Marcy Grate Discharge Ball Mills

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resumed about six months ago following an unprofitable period during the tin restriction.

IRAN—The Ministry of Industry and Mines is negotiating with foreign experts for the beneficiation of a sulphur deposit located near Shiraz. The deposit will supply a chemical fertilizer plant under construction in Shiraz, as well as the local oil industry. The surplus is intended for export.

INDIA—The government was urged to permit mining companies to obtain new leases on areas where geological exploration has been under way for several years, by R. H. Wright, chairman of the **Indian Mining Association** when he spoke at the group's annual meeting this spring. Mr. Wright also said the last year brought a rapid increase in production of all minerals for which demand is growing in line with expansion plans for producing steel, aluminum, and non-ferrous metals.

CYPRUS—**Hellenic Mining Company Ltd.** recently has concentrated activity on the Kalavassos ore body, which last year produced 118,955 tons of pyrite averaging 47 percent sulphur and one percent copper, with most of it going to West Germany. Mines in the company's Mitsero-Agrokipia lease produced 12,680 tons of cupriferous pyrite and 24,425 tons of iron pyrite. At the Kambia-Sha lease, output, after treatment, was 16,297 metric tons of non-cupreous pyrite. Development work there was completed by removal of an additional 46,282 cubic meters of earth. The company's ore beneficiation plant at Vassiliko was in full-scale operation during the year, but that at Mitsero functioned on a reduced basis. In addition to its three mining leases, Hellenic has 27 prospecting permits and carries out extensive exploration.

TURKEY—In the district of Arvin, Ardanuc, in northeastern Turkey, evidences of copper mineralization have been found, but the economic value has not yet been determined.

INDIA—The Kolar gold mining operation, owned by the State Government of Mysore, will be changed into an autonomous corporation in order to get necessary financial aid from the Indian government. The project, which was in the private sector for 75 years, was nationalized in 1956. Expansion is necessary since the grade of ore is decreasing and more low grade ore must be mined to make the operation profitable. Plans under consideration include deeper mining. The **Champion Reef** mine, one of the deepest gold mines in the world, is now operated at a depth of over 10,000 feet.

JAPAN—Three major aluminum producers are sending a survey group to Australia to investigate possibilities for importing bauxite from reserves in the Cape York and Western Australia areas. Japan, which has no bauxite reserves, now needs about 1,000,000 metric tons yearly to supply its growing aluminum industry. Imports last year, about 800,000 tons, came mainly from Ihdonesia, Malaya, and Borneo. The Cape York district bauxite deposits, owned by the **Western Mining Corporation,** have reserves estimated at 20,000,000 tons. Those developed by **Commonwealth Aluminum Corporation** in Western Australia reportedly have several hundred million tons of bauxite.

MALAYA—Malaya's tin export quota for the June quarter is 14,156 tons, equivalent to 95.5 percent of the company's pre-control output. According to Chon Khoon Lin, president of the All-Malaya Chinese Mining Association, it is unlikely that the Chinese section of Malaya's tin mining industry will be able to take full advantage of the increased quota since many of the closed Chinese mines have not reopened because of current high production costs. The tax on fuel oil may deter some operators from reopening mines according to P. A. Delme-Radcliffe, who is president of the F.M.S. Chamber of Mines.

CYPRUS—Exports of cupreous pyrite increased by almost 80,000 tons in 1959, while those of cupreous concentrates went up some 8,000 tons. Iron pyrite exports dropped considerably and exports of cement copper also decreased. Export figures in long tons for the year were: iron pyrite, 659,370; cupreous pyrite, 307,026; cupreous concentrate, 123,159; cement copper, 3,693; chromium ore, 12,176; asbestos, 14,403; gypsum rock, 53,304; gypsum calcined, 1,538; umbers, 3,885, and bentonite, 100.

MALAYA—Although Malayan iron ore producers are not particularly disturbed at the recent contract signed by Japan to import 4,000,000 tons of ore yearly from India, they were concerned with the price agreed on by the two countries. Malay supplies about one-fifth of Japan's annual iron imports and its position as a supplier will not jeopardized, said Kaoru Hayashi, Japanese ambassador in Malaya, who stated that Japan needs as large an amount of iron ore as possible for her ever-expanding industries.

IRAN—Development of barite deposits and construction of a grinding and processing plant will be undertaken by a new company **Magcobar Iran.** The new concern was formed by the **Magnet Cove Barium Corporation** of Houston, Texas, and Iranian partners. Managing director is Charles Hooper.

MALAYA—Iron mining operations will start soon on 10 lots of 258 acres each at Cha'ah in the State of Johore. The project includes plans for construction of an eight-mile railroad from the mine sites to Yong Pen.

KOREA—The government-owned **Korea Tungsten Company** and the **International Ore Corporation** of New York, New York, have agreed to increase monthly volume of Korean tungsten shipments to the United States to 500 tons from the present 300 tons. According to the Ministry of Commerce-Industry, which announced the recent agreement, South Korea tungsten exports to the United States totalled 4,200 tons in 1959. Tungsten represented about one-sixth of Korea's export earnings for the year.

MALAYA—To encourage Malay participation in the mining industry, the government will finance prospecting for tin ore deposits in Malay reservations. The Department of Mines' mineral investigation drilling unit will carry out the prospecting. Also, the financing of Malays in the tin mining industry is one of the major provisions of a five-year, multi-million dollar program being drawn up by the government's Rural and Industrial Development Authority.

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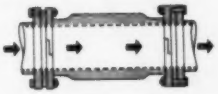

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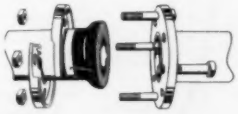

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UNITED ARAB REPUBLIC—This country's first flotation plant began operation recently at the **Ras Gemsa** sulphur mine in the Red Sea province. Messrs. Knapp & Bates Ltd. were prime contractors for the plant which produces 200 tons of sulphur concentrate per day.

UGANDA—An output of 14,000 tons of copper is expected this year from the **Kilembe** copper mine, which produced 12,000 tons during 1959. **Kilembe Copper Cobalt Ltd.** of Canada owns 70 percent of the Kilembe mine and smelter. First quarter profit for the $10,000,000 venture was $215,000.

MOROCCO—During the next few months construction will start on a steel plant at Las Cadenas near the Molouya River estuary, 50 miles from the **Minas del Rif** iron mines in northeast Morocco. According to the government agency **Bureau d'Etudes et de Participations Industrielles (BEPI)**, the plant will have a capacity of 250,000 tons of steel and 20,000 tons of ferro-manganese annually. Estimated cost of the entire project, scheduled to be completed in four years, will be 30,000,000,000 francs, including a new harbor at Las Cadenas on the Mediterranean and a railroad from the mines to the plant. Designed to provide all Moroccan needs for steel and ferro-manganese, the plant will use Moroccan raw material—iron ore from the **Melilla** mines, manganese from the **S.A. des Mines de Bou Arfa** 200 miles southeast of the site, and coke from anthracite from nearby **Djerada** mines.

UNION OF SOUTH AFRICA—**Fritzmoor Exploration,** which mines ore on a 25 percent tribute basis to the **Leeuwbosch** mine, reports that a Japanese firm may advance between £3,000,000 and £5,000,000 for an iron concentration plant in the Thabazimbi area.

SOUTH WEST AFRICA—In the **Berg Aukas** area mineralization has been found to extend to a vertical depth of at least 2,100 feet, and below 500 feet the character of the ore changes from concentration of lead vanadate and lead-zinc sulphides to bodies of zinc silicate, associated with subsidiary amounts of lead and zinc sulphides and lead vanadate. The property is mined by the **South West Africa Company,** which also mines in the Brandberg West area where production is expected to start soon at an initial rate of 20,000 tons of ore a month. Diamond drilling is still in progress to determine the size of the deposit.

UNION OF SOUTH AFRICA—**African Metals Corporation Ltd.,** which recently acquired the ferro-alloy plant of another firm, plans to expand the facilities and also build a factory to produce graphite electrodes at its Kookfontein site near Vereeniging. The project will be operated in association with the **Siemans-Plania** group, using domestic raw materials and will have a capacity of some 3,000 tons of electrodes yearly.

FEDERATION OF RHODESIA & NYASALAND—Prospecting for gold, arsenic and antimony in the Que Que district of southern Rhodesia has been undertaken by **Johannesburg Consolidated Investment Company Ltd.,** one of the leading Rand mining firms that control several gold, base metal, and platinum mines in the Union of South Africa.

NIGERIA—A new company, **Nigerian Lead-Zinc Mining Company Ltd.** will start mining of lead and zinc soon in Abalaliki in eastern Nigeria.

GHANA—Unless hopes of developing major ore bodies are substantiated, it seems unlikely that **Bibiani (1927) Ltd.** can continue its gold mine's milling rate of 30,000 tons a month after October 1962. However the company is continuing underground development, with an expenditure of £158,000 planned this year.

UNION OF SOUTH AFRICA—Platinum demand has decreased somewhat, after abnormal activity earlier in the year. However, **Rustenburg Platinum Mines Ltd.** has maintained output in order to build up stocks which had been reduced to relatively low levels.

FEDERATION OF RHODESIA AND NYASALAND—Total reserves of the **Rhodesian Selection Trust Group** are now 427,000,000 tons of copper ore with

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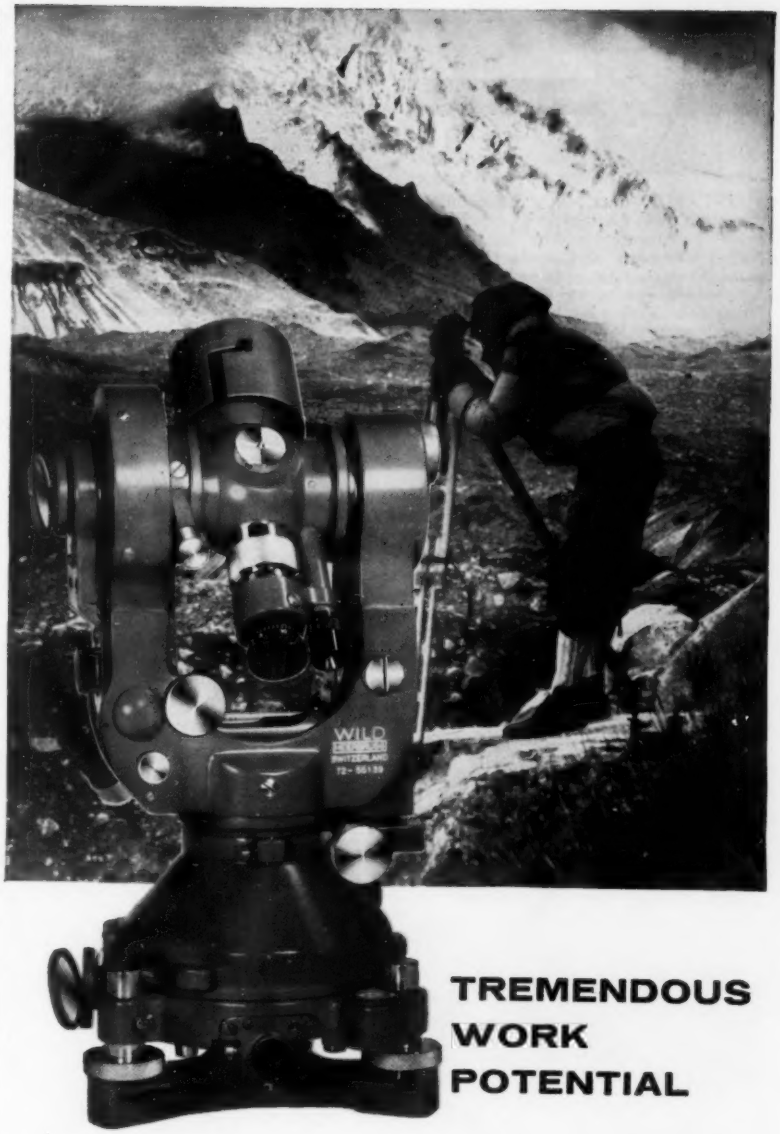
important cobalt values at two properties, representing an increase of 50,000,000 tons during the last fiscal year during which 10,200,000 tons of ore were mined. The new total includes an additional 42,000,000 tons at the undeveloped Baluba property where the grade of copper in the whole ore body is about 2.41 percent, and cobalt about 0.16 percent. Increased reserves in the western part of the Mulfulira ore body brings total ore discovered in the past three years at this ore body to over 53,000,000 tons. In addition to the reported reserves there is a small high-grade ore body of some 2,000,000 tons recently found to the west of the main Chibuluma ore body, a tonnage double that indicated last year. Average copper grade has increased to 4.74 percent. Aimed toward completion in 1962, development at Mulfulira West is expected to have increased its production capacity by about 50 percent by the middle of that year. Sinking and concrete lining of the Prain rock and service shafts have been completed to depths of 2,700 feet. A connection has also been made on the 1,650 foot level to the crosscut driven from the Selkirk shaft, nearly two miles away. **American Metal Climax Company** owns 50.61 percent of Rhodesian Selection Trust.

GHANA—Exploration of the northern ore shoot above and below the No. 18 level is being emphasized by **Bibiani (1927) Ltd.** this year. A series of raises has been started from the No. 18 level between 60 N. and 70 N. An intermediate level, No. 16½, will be established from which further driving and cross-cutting will be done. Diamond drilling has indicated good widths and values below the No. 18 level, the deepest intersection being at No. 20½ Level horizon. The No. 21 Level is being driven towards this area and a winge being sunk from 62 N.W. Crosscut on the No. 18 Level. On the south ore body, the company has started a raise from the No. 24 level to prove the ore shoot between No. 24 and 21 Levels, and diamond drilling will test the extent below the 24 Level. During the current year the milling rate will be maintained at 30,000 tons per month, yielding approximately 7,000 ounces of gold.

FEDERATION OF RHODESIA & NYASALAND—Hydrolectric power from the new Kariba power station on the Zambezi river is now reaching the Copperbelt, averting a threatened power shortage which resulted from the inability of the Belgian Congo to meet its full commitments to the Copperbelt because of water shortage.

REPUBLIC OF GUINEA—Exploration in the southern part of the Simandou Mountains not far from the Liberian border has resulted in location of iron in the Fon Range. The Deposit is over three kilometers long, 800 meters wide, with a depth of 150 to 200 meters. Iron content is reportedly more than 66 percent. Several outcroppings, about 800 meters long and 200 deep, have also been located in the Oueleba mountains. The ore contains hematite, mainly, with a proportionately small amount of magnetite. Exploration was undertaken by the **Bureau d'Etudes Geologiques et Minieres** and the **Service de Geologie et de Prospection Miniere** of Dakar. Interest in the iron deposits has been expressed by several groups.



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ONTARIO—Start of a new mining operation, the **Clarabelle** Open Pit, has been announced by **The International Nickel Company of Canada Ltd.** to replace tonnage now obtained from other Inco mines. Production at the new mine, on an outcropping ore body southwest of the company's **Murray** mine in the Sudbury district, will start in the latter part of 1961. Preparations such as stripping rock overburden and surface plant construction will begin soon and, when required, mining equipment will be transferred from Inco's **Frood** open-pit mine where operations are approaching completion. Surface dimensions of the new mine will be approximately 2,500 feet long by 150 to 500 feet wide. The company also plans to sink a 3,000-foot shaft to the north of Copper Cliff for exploration of the formation of the Copper Cliff Offset, following necessary surface plant construction.

QUEBEC—A promising copper-zinc find has been made by **East Sullivan Mines Ltd.** in Stratford Township in the Lake Aylmer district about 50 miles northeast of Sherbrooke. Diamond drilling, limited so far because the area is relatively close to the boundary of the **Hastings Mining and Development Company** property, indicates a zone of massive sulphides in which high grade intersections of copper and zinc have been obtained in widths from four to 10 feet. East Sullivan with two other firms has now acquired control of the Hastings firm and plans a full-scale exploration of the area.

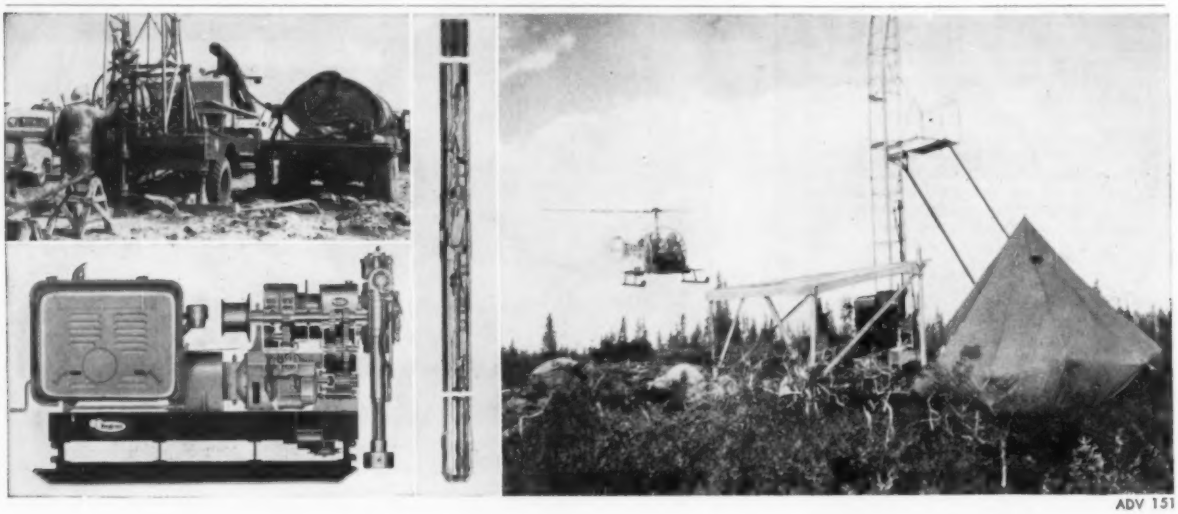
BRITISH COLUMBIA—A $10,000 exploration program has been undertaken at a 32-claim property two miles southeast of Greenwood by **Magnum Copper, Centennial Mines and Tombac Exploration, Ltd.** Under an option agreement with **West-Coast Resources, Ltd.**, they can acquire full title by doing additional work, forming a new 5,000,000-share company, and issuing half the shares to West-Coast.

ONTARIO—Developments during the last year by **Viola-Mac Mines Ltd.** established the period as the company's most successful. In Kam-Kotia, the company found a copper ore body of sufficient size and grade to justify a 750-ton per day operation. In Albino, the firm has a large share in an interesting gold property in the Red Lake camp. In its Lake Cinch operation the company cancelled its contract with **Loradio Uranium Mines Ltd.** for $2,500,000 and hopes to begin a new mining operation soon. Recently six claims were purchased and 18 claims taken under option, all adjoining the Kam-Kotia Porcupine Property.

ONTARIO—**Madsen Red Lake Gold Mines Ltd.** produced 118,804.674 ounces of gold during 1959 from 301,999 tons of ore milled. Recovery of silver totalled 20,276,860 ounces. The establishment of the No. 3 ore zone in the East section of the mine at Madsen, Ontario, was confirmed by diamond drilling from the 16th level drift. To date four ore bodies have been indicated by diamond drilling, containing an estimated 56,000 tons of ore averaging 0.28 ounces per ton between the 17th to 15th levels. Total ore reserves for the company at year-end amounted to 604,150 tons of an average grade of 0.330 ounces, excluding the new East ore zone.

NORTHWEST TERRITORIES—Drilling on property in Flat River was started in mid-May by **Canada Tungsten Mining Corporation**, which also plans a program of geological mapping covering all its 83 claims located some 150 miles north of Watson Lake, Yukon Territory. The two-phase drilling project will include one machine to detail the main tungsten deposit on which earlier drilling indicated 1,166,351 tons grading 2.18 percent WO_3. A second drill will investigate other known showings. Preparations included shipping over 400 tons of supplies by air. Canada Tungsten was incorporated last summer out of the **MacKenzie Syndicate** comprising several mining concerns.

BRITISH COLUMBIA—**Bralorne Pioneer Mines, Ltd.**, the province's largest gold operation, produced $4,700,000 worth of the yellow metal in 1959. A total of 143,113 ounces of gold was recovered from 223,868 tons of ore milled. Mine operating costs were $24.28 per ounce of gold recovered. Reserves were estimated at 766,000 tons averaging 0.73 of an ounce.



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NEWFOUNDLAND—Preparation to resume fluorspar production at its mines near St. Lawrence has been started by **St. Lawrence Corporation of Newfoundland**, which had suspended operations for nearly three years. Actual reopening of the **Hares Ears** mine began some months ago, while deepening of one shaft at the **Blue Beach** mine is planned soon. The Blue Beach vein is the largest found on the St. Lawrence properties. Initial operations of the company will be at only 25 percent of capacity, with a gradual rise to about 30,000 to 40,000 tons annually. St. Lawrence has a 100-ton per day flotation mill and a 400-ton per day sink-float plant on its properties. Its 1956 production was 73,000 tons of fluorspar concentrate.

SASKATCHEWAN — The undelivered portion of the uranium contract held by **Lorado Uranium Mines** has been purchased by **Eldorado Mining and Refining Ltd.**, government company operating uranium mines at Beaverlodge Lake. Since deliveries of about 4,000,000 pounds of U_3O_8 are involved, the Beaverlodge mine now has contracts that will permit its continued operation until early in 1964. **Gunnar Mines** in the same district is expected to operate about the same length of time. Eldorado's **Great Bear Lake** mine is expected to close this fall.

ONTARIO—**Giant Yellowknife Gold Mines Ltd.** milled 186,687 tons of ore in the six months ending December 31, 1959, recovering 117,126.658 ounces of gold and 11,742.79 ounces of silver. Comparative figures for the like period the preceding year were 146,695 tons; 79,201.590 ounces of gold, and 10,687.95 ounces of silver.

ONTARIO—Mill facilities of **Langis Silver and Cobalt Mining Company** will be tripled to a capacity of some 200 tons a day with installation of new equipment. A new ball mill, flotation cells, jigs, and tables will be installed this spring. Production of the company last year was a record 1,129,763 ounces of silver. Since the start of this year ore has been located in both the No. 3 and No. 6 shaft areas of the Langis property. Broken ore reserves at the end of last year amounted to 7,000 tons. Langis began milling operations in 1956 and production has steadily increased each year.

CANADA—Mining products led all other export groups in 1959 with an all-time record value of $2,121,314,277, including gold, which totalled $129,213,447. Non-ferrous metals amounted to $1,114,467,332; iron and its products, $563,398,105, and non-metals, $294,235,393. Exports of 11 major primary metals were also at an all-time high, with iron making the largest gain and uranium exports totalling $311,904,143, a new high.

QUEBEC — **Campbell Chibougamau Mines Ltd.**, which increased its profits sharply during 1959, will also enlarge its operations considerably—by expanding mill capacity, increasing mine production and deep development at its main mine. The company has also discovered a new major ore zone at its **Cedar Bay** property where a strike length of over 1,000 feet is to be explored. Shaft sinking at its **Henderson** property should be completed soon, and first development ore is expected to be mined in April. At the main mine the company has decided to develop a major ore occurrence, which seems to be a repetition of the main zone at depth, by sinking a shaft to the 3,700-foot horizon. Production goal for Henderson is to be 1,200 tons daily, and at **Kokko Creek**, 400 tons daily. Capacity of the mill on Merrill Island will be increased to 2,400 tons daily.

ONTARIO—Continued encouraging results are reported on the six deep levels under development at the Kirkland Lake gold property of **Wright-Hargreaves Mines.** In the last year 953 feet of ore was developed, assaying 0.67 ounces per ton. Total ore developed on the six deep levels (7,200 to 8,200-foot horizons) is 3,300 feet, averaging better than 0.60 ounces per ton. About 450 tons per day are shipped to the mill of **Lake Shore Mines**, which controls the Wright company.

OCEANIA

WESTERN AUSTRALIA—**Broken Hill Proprietary Company Ltd.** plans immediate construction of facilities on Koolan Island in Yampi Sound so that open pit mining can begin. A cargo wharf, access roads, and ain airstrip will be built, and a construction labor force of 300 is expected. Plant and equipment will include large electric shovels loading to off-highway, end-dumping diesel trucks of about 50-ton capacity, delivering to a two-stage crushing plant. Conveyor belts will transport ore from that plant to a storage area and thence to the shiploading plant where vessels will be loaded at a rate of 2,500 to 3,000 tons per hour at any stage of the tide. The high-tonnage plant will be capable of handling at least 2,000,000 tons of ore annually. A power station and community facilities are also planned for the project, which is expected to result in a township with a population of about 600.

REPUBLIC OF THE PHILIPPINES—**Itogon-Suyoc Mines** produced 4,098 ounces of gold and 1,878 ounces of silver, valued as Pesos 617,901 during March. The Itogon mill produced 2,576.147 ounces of gold and Suyoc 1,521.907 ounces, for a combined production record for the two mines.

QUEENSLAND — **Mining Corporation N. L.**, Mount Isa, has stopped drilling its No. 5 hole at 2,542 feet since some uneconomic copper mineralization was intersected. Drilling of the No. 6 hole has started, to test ground west of the No. 5.

NEW SOUTH WALES—Twelve companies produced the state's total of 46,283 tons of rutile last year compared with 46,491 tons the year before. Zircon production in 1959 rose by 39,235 tons to 71,777 tons.

REPUBLIC OF THE PHILIPPINES—The **Toledo** copper mine of **Atlas Consolidated Mining and Development Corporation** treated 288,809 tons of ore averaging

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0.62 percent copper during March. Concentrates totalled 5,436 dry short tons, assaying 27.65 percent copper and 12 ounces of gold per ton, and containing 3,033,686 pounds of copper and 652.3 ounces of gold. Shipments from the **Mati Iron Mines** totalled 8,600 tons of iron concentrates having a value of Pesos 190,552.

QUEENSLAND—Construction of a second water storage dam costing £A250,000 is planned by **Mary Kathleen Uranium Ltd.** The dam will be built by Thiess Brothers, who also built the Lake Corella dam for the firm. Exploration and development by Mary Kathleen Uranium indicate that its uranium deposits have a much longer life than was originally supposed. However, its present sales contract expires in 1965 and a new one has not yet been announced.

WESTERN AUSTRALIA—**Howe Sound Company**, of the United States, which has mining operations in several countries, is engaged in a joint venture with Australian interests for lease and operation of a magnesite deposit in Western Australia.

NEW GUINEA—**Australian Gold Development N.L.** and **King Island Sheelite N.L.** have relinquished the option held on the Mount Victor area, near Kainantu where testing for possible gold mining has been under way for the last few years.

QUEENSLAND — **Copper Refineries Proprietary Ltd.** is making good progress at its refinery opened last October at Townsville. Output has already reached 40,000 tons of copper, of which 8,000 tons was exported. The refinery's annual output rate of 40,000 tons is being stepped up to 60,000, and a future capacity of 100,000 tons is thought possible. The company's rolling mill is well under way, with production of rod and wire expected to start soon.

YUGOSLAVIA—More extensive reserves have been indicated in the **Lece** gold-lead-zinc mines in southern Serbia, where previous estimates showed reserves sufficient for two years' mining. Reserves are now thought to be about 800,000 tons, or enough for a further five or six years of uninterrupted operation. Continued exploration, improvement in methods of gold extraction, and a solution to transportation problems will be necessary for full development.

SWEDEN—**LKAB** will begin test mining at Leveaniemi in the Svappavarra district 45 kilometers from Kiruna, planning to mine open-pit 300,000 tons of iron ore by the end of 1962. During this period prospecting will be continued, along with sorting and concentration tests. The ore body begins 12 meters below surface, continuing to a depth of 400 meters. About 100,000,000 tons of ore are indicated at the deposit, which is in an area where copper was mined in the 1600's.

FINLAND—In the Kemi district of northern Finland a promising deposit of chromite has been located, with a chromium content averaging about 20 percent. Exploratory mapping indicates about 15,000,000 tons in a vein several miles long and about seven feet wide.

SPAIN—**Minera de Covadonga** in the Province of Oviedo will install three testing furnaces for sintering. **I. R. Minero-Metalurgico** plans a blast furnace for lead processing.

DENMARK—The International Geological Congress will hold its twenty-first session in Copenhagen August 15 to 25, with headquarters at the Mineralogisk Museum of the University of Denmark. Organizing committee for the session is comprised of geologists from the five Nordic countries—Denmark, Finland, Iceland, Norway, and Sweden. The meeting is under the patronage of King Frederik of Denmark. Over 3,000 persons are expected to attend the session which will have over 20 subjects for discussion, including geochemical cycles, geological results of applied geochemistry and physics, genetic problems of ores, stratigraphy, regional paleography, and many others. Eight affiliated associations and societies will hold meetings during the session, as well as several commissions and subcommissions of the Congress. Excursions and tours of varying length to areas of interest in Scandinavia have been arranged.

SWEDEN—**Boliden Mining Company** will prospect two new sulphide ore deposits this year. At the Udden deposit near the **Kedtrask** mine, diamond drilling has indicated contents of 25 to 30 percent S, 5 to 6 percent Zn, and some Cu, Ag, and Au. The known ore body is about 3,000,000 tons. Shaft sinking will be undertaken this summer to the 425-meter level. At the other deposit, called the Nasliden ore body, shaft sinking to the 420-meter level will be started this summer. Here, the 1,800,000-ton deposit has a content of 28 percent S, 3 percent Zn, and about 1 percent Cu.

YUGOSLAVIA—Macedonia now produces about 230,000 tons of lead-zinc ores, 100,000 tons of chromium ores, and about 6,000 tons of manganese and other minerals per year. Ores are processed into concentrates at the mines, before delivery to smelters in different parts of the country. Exploration continues for iron-nickel ores at Rzanova, where reserves of 17,000,000 tons have been indicated, and at Kicevo, which has an estimated 150,000,000 tons of good quality iron ore. Both the Institute for Geology of the Yugoslav Federation and the Institute for Macedonia are financing exploration in various places for lead and zinc, molybdenum, manganese, chromium, cobalt, copper, feldspar, asbestos, bentonite, sulphur, and marble.

SWEDEN—Iron ore from Sweden, along with 750 tons of coal from Norway, (Spitzbergen), will be sent this spring to an American pilot plant for testing.

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congress will be held September 12 to 18 in Budapest by the Hungarian Mining and Metallurgical Society. Papers may be read in Hungarian, English, Russian, or German. Following the congress there will be excursions to various mining operations, including the Transdanubian manganese and bauxite area, and the mountains of Tokajhegyalja.

YUGOSLAVIA — Copper ore reserves have been discovered in Eastern Serbia, in the mountains between Majkdan Pek and Knjazevac. One small mine, the **Lipa**, is already in operation under management of the **Bor** copper mining interests, which have major control of all these reserves. Further deep drilling is planned for the area, which is so remotely located that roads, aerial ropeways, or railways must be constructed before full scale operations can begin. The ore is said to average about 2.0 percent copper, but also contains other metals. Reserves are reportedly large.

SPAIN—Increased activity in iron mining is forecast during this year, with greater exports, reopening of mines and development of a previously undiscovered deposit near San Emiliano (Leon) near the Luna reservoir not far from the **Wagner** and **Vivaldi** mines. The deposit is in an area covering 50,000 hectares and reserves are reportedly estimated at 600,000,000 tons. The recently re-opened iron deposits near Villalba (Lugo) are producing 30,000 tons of ore for export to Germany this spring and total exports for the northwest region of Spain are expected to be over 800,000 tons this year. Spanish iron ore production totalled 4,700,000 tons in 1959; exports for the first 11 months of the year were 2,500,000 tons, including pyrites.

FINLAND—A previously unknow iron ore deposit has been located near Kolari, about 100 kilometers north of the Arctic Circle in Finnish Lapland. No definite plans have been made for mining the deposit, said to contain at least 50,000,000 tons of ore.

SPAIN—Prospecting in the Cordoba mountains has led to discovery of some barite deposits, copper, and antimony ore near Quejigo, and feldspar near Alhondeguilla.

NORWAY—Northern Europe's deepest shaft will be sunk by **Fosdalen Bergverk** at Malm in the district of North Trondelag where drilling indicates iron ore reserves sufficient for 15 years' production. The shaft will be sunk 1,000 meters.

YUGOSLAVIA—Construction of an aluminum plant on the Dalmatian coast is planned by the Institute for Light Metals in Zagreb. The area in which the plant will be built has many bauxite deposits whose ore has been exported. Geological prospecting is expected to be completed by mid-year. Power plants under construction in the northern and mid-Adriatic area are the Senj, the Peruca, and the Split plants, which are expected to start initial operations this year, reaching full capacity between 1963 and 1965.

NORWAY—Expansion of the aluminum industry now under way might make Norway Europe's largest aluminum producer, according to N. Ramm, managing director of the **Norsk Aluminium Company.** When all projects now under construction are completed, the country's capacity will be 230,000 metric tons a year, with further increases probable.

SPAIN—A new pyrite roasting furnace has recently been installed by Pagra in the Province of Cordoba. The Spanish government recently decreed that all factories that process pyrite cinders are declared of "national interest," meaning they have certain tax reductions and other advantages.

NORWAY—The Norwegian Ministry of Industries has made plans for development of iron ore deposits in the Dunderland Valley in northern Norway, where experimental operations have been under way for some time. It is hoped that these deposits, reportedly quite large, will supply the Norwegian steel and iron works at Mo-i-rana.

YUGOSLAVIA—The extensive expansion of the **Majdanpek** copper mining operation, begun in 1956, is being accelerated, with recent plans calling for import of special machinery. The mine will be open-pit, scheduled to produce 3,600,000 tons yearly for the new flotation mill. Development of the mine includes excavation and removal of 13,000,000 cubic meters of waste capping. At the **Bor** copper mine, 30 miles distant, approval has been obtained for smelting furnaces of 55,000-tons-yearly capacity, including an auxiliary plant. A sulphuric acid plant with an annual capacity of 230,000 tons will also be built, as well as a fertilizer plant, in Pravoho on the Danube, that will use sulphuric acid produced at Bor.

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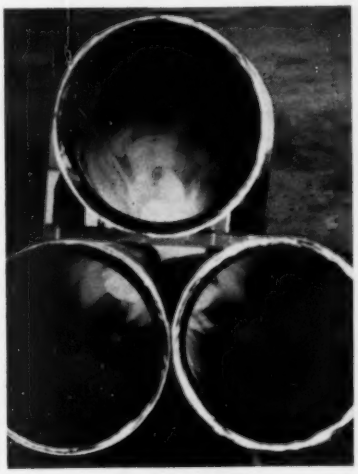

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1—10 HP Sullivan A-312 3 Drum Electric Slusher
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1—3' x 6' Morse New Rod Mill
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3—4" x 6" New Morse Lab Crushers
1—5" x 6" New Morse Jaw Crusher
1—6" x 7½" Hendy Crusher
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1—20" x 36" Diamond Roller Bearing, Steel Plate, Jaw Crusher

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1—3' x 6' Oliver Drum Filter.
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1—4 Ton General Electric Battery Locomotive
1—6 Ton Goodman Trolley Locomotive
2—6 Ton Jeffrey Trolley Locomotive
2—6 Ton General Electric Battery Locomotives
1—7 Ton Atlas Battery Locomotive
2—8 Ton General Electric Battery Locomotives
3—8 Ton Ironton Battery Locomotives
1—9 Ton Whitcomb Battery Locomotive
4—10 Ton Atlas Battery Locomotives
2—10 Ton Jeffrey Trolley Locomotives
1—13 Ton Jeffrey Trolley Locomotive
1—13 Ton Goodman Trolley Locomotive
1—15 Ton Jeffrey Trolley Locomotive

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3—4" x 6" New Morse lab jaw crushers
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7—Model HB Gardner Denver Air Tugger
12—Model L111 Joy Air Tugger
22—Model HU Ingersoll Rand Air Tugger
11—Model FF211 Joy 2 drum Slusher, 220/440 V.
1—Model 5NNOH IR Slusher, 220/440 V.
18—Model 10 NNIG IR Slusher, 220/440 V.
1—Model FF311 Joy 3 Drum Slusher, 220/440 V.
1—Model 15 NM2F IR 2 Drum, 220/440 V.

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1—4 Ton Atlas Battery Locomotive, 24″ ga. Complete
1—4 Ton Mancha "Titan A" Battery Locomotive 24″ ga.
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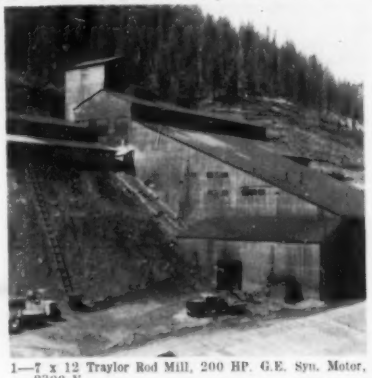

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1—600 cfm I-R Gyro-flo, Diesel
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1—210 cfm Schramm, gas

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1—16″ x 15′ belt, troughing
1—24″ x 45′ Barber-Greene troughing portable

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1—Thor, Model 200, Stoper
1—I-R, 4″, mounted on HD—5
1—I-R, 4″ Wagon drill
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7—A-C-P, 46 lb. Jackhammers

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1—40′, 6″ bucket
1—28′, 6″ bucket

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1—Caterpillar, 12

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4—28′ x 10′ Wemco w/tank

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1—Coppus 9, 25HP

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1—6-Cell (28x28) Denver Sub-A Flotation Machine.

1—GD-9 Gardner-Denver Mucker, 18" Ga.

1—GD-10 Gardner-Denver Mucker, 18/24" Ga.

2—No. 12-B Eimco Muckers, 18/24" Ga.

2—No. 21 Eimco Muckers, 24" Ga.

1—No. 40-H Eimco Mucker, 36/24" Ga.

1—4½-Ton Atlas Battery Locomotive, 24" Ga.

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